Design Handbook

For Neighborhood Infill & Redevelopment Using Resource Efficient Methods & Materials

Community Development Block Grant

July 25, 2003

Prepared in cooperation with:

Habitat for Humanity

James N. Gray Company

Lexington Fayette Urban County Government

Acknowledgements

This Design Handbook for urban, infill housing was funded by a Community Development Block Grant from the Lexington-Fayette Government to Lexington Habitat for Humanity.

The Design Handbook was prepared as a collaboration between Lexington Habitat for Humanity, James N. Gray Company, and the Lexington-Fayette Urban County Current Planning Department.

Our acknowledgement, thanks and appreciation are extended to those other departments, organizations and business enterprises throughout our community that participated in three public workshops. Their workshop contributions had a material effect on the outcome of the Design Handbook and their willing participation in this effort is sincerely appreciated.

Workshop participants:

Organization	Name
Faith Community Housing Foundation	Bill Embry
Lexington Downtown Development Authority	Harold Tate
REACH	Nancy Parker
Lexington-Fayette Urban League	Norman Franklin
Community Action Council	Jim Christian
Community Ventures Corporation	Myron Agnew
HEAL	Don Sullivan
Habitat for Humanity International "Green Team"	Graham Davis
Kentucky Heritage Council	Craig Potts
Kentucky Heritage Council	Scot Walters
Padgett Construction Company	Greg Padgett
Sheeran Construction Company/LHBA	Tom Sheeran
LFUCG Division of Building Inspection	Bob Carpenter
EHI Consultants	Ed Holmes
LFUCG Historic Preservation	Dean Doerrfeld
LFUCG Planning Division	Bill Sallee
LFUCG Planning Services	Chris King
LFUCG Community Development Division	Mike Marinaro
LFUCG Code Enforcement	Virgil Carter
LFUCG Community Development Division	Paula King
UK College of Architecture	David Mohney
UK College of Architecture	Dana Cox

Appreciation is also extended to individuals involved in the review of the Design Handbook.

Organization:	Name:
Lexington Habitat for Humanity	Grant Phelps
Lexington Habitat for Humanity	April Smith
Lexington Habitat for Humanity	Kevin Stagner
LFUCG Current Planning	Henry Jackson
LFUCG Division of Planning	Chris King
LFUCG Division of Planning	Barb Rackers
LFUCG Division of Building Inspection	Bob Carpenter
LFUCG Historic Preservation	Dean Doerrfield
LFUCG Landscape	Belinda Labadie
LFUCG Urban Forester	Tim Queary
LFUCG Code Enforcement	Martha Alexander
Lexington Community Development Corporation	Harold Tate
James N. Gray Company	Dennis Bopp
James N. Gray Company	Stephanie Gilbert
Lyons Company, Inc.	Vince Foushee, P.E.

Content for the Design Handbook was derived from numerous existing resources:

Design Advice
Metropolitan Historic Zoning Commission
Lousiville, Kentucky

Green Building Guidelines
Meeting the demand for low-energy resource-efficient homes
Produced by the Sustainable Buildings Industry Council with support from U.S. Department of Energy's Office of Building Technology, State and Community Programs and the National Renewable Energy Laboratory

Green & Lean
Designing and Building an Affordable, Resource-efficient Home
GreenHOME, Inc.
Washington, DC

Green Team Training Booklets, Construction & Environmental Resources
Habitat for Humanity International

Acknowledgements

LFUCG Zoning Ordinance

Materials Management Program Manual
Habitat for Humanity International

Sustainable Design, Construction and Land Development, Guidelines for the Southeast
South Energy Institute

EarthCraft House Program and Checklist
Southface Energy Institute

Content was also extracted from many publicly funded Web sites,

U.S. Department of Energy

U.S. Green Building Council

Southface Energy Institute

This document was prepared as a Community Development Block Grant sponsored by Lexington -Fayette Urban County Government. Neither the local government nor any agency thereof, nor Habitat for Humanity nor James N. Gray Company, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe upon privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the Government, agency thereof, or the authors of the document. The views and opinions of authors expressed herein do not necessarily state or reflect those of the Government for any agency thereof.

Table of Contents

HANDBOOK SUMMARY

Section 1

Finding, affording and maintaining a place to live for families of very low income are often very arduous tasks. Harvard University's Joint Center for Housing Studies estimates that more than 14 million U.S. households pay more than 50 percent of their income for housing. This struggle is very familiar to organizations within our community actively seeking to address issues of substandard housing.

Habitat for Humanity's ability to leverage and manage volunteer labor and donated materials is the cornerstone of their success in providing affordable housing. The Lexington affiliate has provided over 195 simple, affordable homes to families of very low income through renovation and new construction over the past 17 years. Of these home sites, the majority are located within the urban services area and within our older established neighborhoods. Development within these neighborhoods must be carefully considered in order to enhance the livability and value of those areas.

This handbook is intended to lay a foundation of information and application that provides conceptual definition to issues surrounding low-income urban infill developments - specifically using sustainable concepts. It is not intended to replace standard design and construction procedures and practices of evaluating project specific issues and requirements.

This Design Handbook seeks to respond to questions such as:

- What is neighborhood compatibility?
- What does appropriate infill design look like?
- What is "Green" construction? What does it mean relative to low-income housing?
- How can energy efficiency be increased?

For the purpose of illustration, modifications to basic home designs that Lexington Habitat typically build were made to provide tangible examples of design strategies that address these questions relative to areas outlined below.

The Habitat model addresses many fundamental issues that have broad applications and benefits to nonprofit organizations, for-profit builders/developers and private citizens who have an interest in developing affordable housing.

- Neighborhood Compatibility
- Site Considerations
- Energy Efficiency
- Material Selection

By careful consideration and integration of issues such as these into the design and execution process, the handbook can assist the user in responding to community goals such as:

- Elimination of substandard housing in our community
- Revitalization of existing neighborhoods through quality infill construction
- Promotion of the stewardship of our natural resources

While many topics in this publication apply to many forms of development and housing markets, the primary focus is on low-income, urban, infill housing. Other options for providing low-income housing exist, and are encouraged where possible, such as rehabilitation of existing structures.

The handbook is divided into six different sections. At the end of each section a topical checklist is provided, along with additional links and resources pertinent to the section topic to point the reader to other sources for further inquiry. All items on the checklists are not necessarily pertinent to each project nor should they all be used together. The checklists are provided as a planning and management tool.

NEIGHBORHOODS:
Section 2

Design Matters
Context & Compatibility
Architectural Principals
Checklist and Links and Resources

Building strong neighborhoods is essential to maintaining the vitality and livability of our community. One of the steps to building strong neighborhoods is providing appropriate infill design that respects and enhances the value of our existing neighborhoods. Providing quality infill construction within the downtown core is a recognized community goal manifested in the recent adoption of the "Residential Infill Design Standards" into LFUCG's Zoning Ordinance. The City is actively seeking to foster high quality compatible infill and assist in removing obstacles from opportunities for infill developments.

Good infill development conserves economic investment; it utilizes existing infrastructure, (i.e., roads and services, access to existing public transportation), and it preserves the physical identity and social patterns existing within the neighborhood. A sustainable byproduct of this densification of the urban core means that valuable and cherished green space is not consumed.

In response to the LFUCG's "Residential Infill Design Standards", this handbook will focus on design issues that affect neighborhood compatibility as it pertains to low-income infill housing.

What is a neighborhood?

A neighborhood is one of the fundamental building blocks of a community, along with other institutions such as religious organizations and schools.

- They are places where people meet people and share experiences and values.
- They provide opportunities of interaction and common identity.
- They are places where people develop their sense of ownership, belonging, and participation in the community.

The urban and architectural flavor differs from neighborhood to neighborhood with varying setbacks, lot sizes, architectural styles and materials that define the physical appearance of the neighborhood. Good infill development should be responsive to the physical character of the neighborhood, as well as the social and economic patterns. Good infill should integrate and reinforce the culture of the neighborhood. The example on the right is clearly identifiable as a neighborhood street. The houses are all oriented to the street and they are of a pedestrian scale. There are porches where neighbors can casually visit with neighbor. The houses together establish an urban fabric. This image expresses a positive quality of life.

"Anything is not better than nothing."

Providing appropriate affordable infill housing is a goal that encompasses more than economically keeping the resident out of the weather. The example on the left is clearly not a neighborhood. Large housing complexes do not create neighborhoods. They are typically not pedestrian oriented, out of scale, and they provide little to no opportunity for neighborhood interaction and identity. Many well-intended government and private development projects whose single-minded goal of economically keeping people out of the weather resulted in housing blocks that interrupted physical and social patterns. These solutions did not provide opportunities for pride in home ownership or interaction and identity within the neighborhood. This old model is not sustainable and has resulted in additional tax dollars being spent to demolish them.

These are some examples of why.... design matters!




Context & Compatability

The different architectural styles represent social values, economic trends, aesthetic fashions, and building technologies of the day. Through the architectural styles and land-use patterns, our neighborhoods chronicle the city's evolution in terms of social patterns, population growth and shifts, and economic health.

Most neighborhoods, where low-income residential infill opportunities exist, are eclectic and display a variety and richness of architectural styles, as well as variations on architectural styles. However, in most of these neighborhoods, there are predominantly simplified versions of three styles: Victorian, Colonial (revival), and Bungalow.

Because of the eclectic nature of the neighborhoods, the land-use pattern and the overall scale and nature of the street is arguably more important to the unity and identity of the neighborhood than is the specific architectural style of individual homes. The scale and land-use pattern unites the various styles and provides order. To be compatible, the new infill construction must respect and maintain the overall nature and scale of the neighborhood.

The new infill development should make a contemporary contribution to the continuing evolution of the neighborhood and the community rather than focusing on replicating a specific historic style. Compatibility issues are addressed by focusing on overriding neighborhood patterns of scale, proportion, street orientation, roof type, and materials - not only of the contiguous properties, but also the entire street. Recognizing these concepts and understanding the basic patterns will assist in forming an appropriate contemporary infill design solution that utilizes current construction and design philosophies, that is compatible and enhances the life of the neighborhood. These concepts are further diagramed on the following page.

(Site Considerations and land-use patterns are discussed in Section 4)

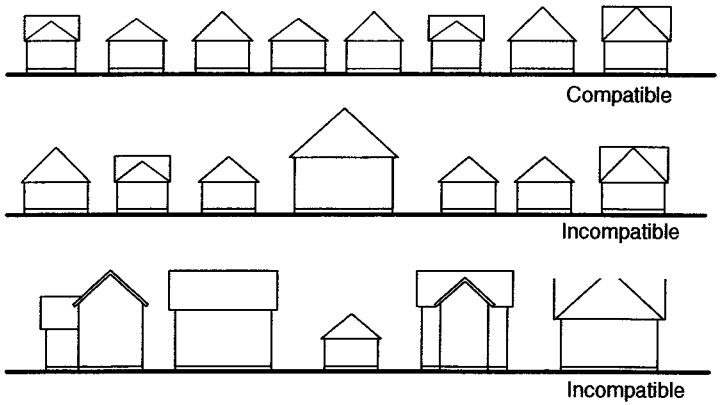
Architectural Principals
There are predominant styles that are simple versions of Victorian, Colonial, and Bungalow, in most of the areas where low income infill opportunities are prevelant. The concepts of scale, proportion, roof type, street orientation and materials are discussed relative to each style.

Colonial Federal Victorian Bungalow

Massing
- Colonial / Federal - Massing is very simple and often symmetrical
- Victorian- Massing often asymmetrical and often complex
- Bungalow - Massing varies from symmetrical to asymmetrical

Proportion
- Colonial / Federal
- Victorian - Strong vertical emphasis
- Bungalow - Strong horizontal emphasis

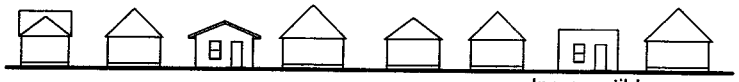
Scale
Scale is relative depending on adjacent properties.



Compatible
Incompatible
Incompatible

Roof Type
- Colonial / Federal - Simple hip or gable - dormers are typical. Typical roof slopes: Range from 6 in 12 to 10 in 12
- Victorian - Complex - Varies from hip to gable - Typical roof slope: 12 in 12
- Bungalow - Main roof often hip with gable accents, deep roof overhangs, roof rafters are often exposed
  Typical roof slopes: 6 in 12 or 8 in 12

Street Orientation



Incompatible

Historical houses of all styles exhibit a strong street orientation. The entry occurs on the front of the house facing the street. The front is often further emphasized with a porch. Porches are a very important neighborhood amenity and are typical on most houses within these neighborhoods. Porches are a key element that affords neighbors the opportunity to connect with other neighbors.

- All styles: Porches often have a shallow slope relative to the main roof

Compatible

Materials
- Colonial / Federal - Very orderly relationship of elements, single material on body of house
- Victorian - Features and details often elaborate and intricate, use of multiple materials on body of house
- Bungalow - Single material on body of house common.

The main material observed within Lexington's moderate to low-income neighborhoods is wood siding. Some brick and stone homes exist, but typically brick and stone is used on limited areas of the porch.

* (Highlighed area indicates new infill construction)

Check List and Links and Resources

Neighborhood Check List

☐ For any infill project, it is important to take the time to walk around the neighborhood and make note of major neighborhood features, such as:

- style
- scale
- massing
- proportion
- roof type
- street orientation
- materials

☐ Integrate observations into the planning process of the infill development.

☐ Review the proposed design during the planning phase with the LFUCG Zoning Office, Historic Preservation Office, and others if applicable.

Links and Resources

For information regarding requirements of new infill construction, refer to the following publications:

LFUCG Zoning Ordinance and Submission Regulations

LFUCG Residential Infill Design Standards (within the Zoning Ordinance)

"Guidebook for Property Owners, a guidebook to understand H-1 zoning in Lexington, Fayette County, Kentucky"
prepared by the Division of Historic Preservation
This publication documents the different historic neighborhoods and addresses the Board of Architectural Review process

"Design Guidelines"
prepared by the Historic Preservation Commission
These are the adopted zoning requirements per Article 13 of the LFUCG Zoning Code.
This document provides more specific information pertaining to design principles, design context, site, rehab, and new construction.

"The Secretary of Interior's Standards for Rehabilitation"
prepared by the National Park Service
http://www2.cr.nps.gov/tps/tax/rhb/

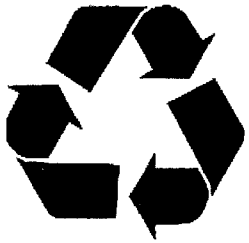
SUSTAINABILITY

Section 3

What is "Green?"
Sustainability for Affordable Housing
Why is Sustainability Important?

What is "Green"?

Sustainable development is defined by the Southface Institute as development that allows for economic well-being, environmental protection, and overall quality of life for people today without compromising the ability of future generations to meet these needs.



The general public was first introduced to "green", sustainable concepts via trash recycling programs, and it is what the general public understands as a commitment to reducing pollution and saving natural resources by re-using (recycling) used manufactured materials such as paper, glass, appliances, etc. And while there are public awareness programs that address global warming and the depletion of our natural resources, the direct correlation to the use of natural, recyclable resources for use in home construction does not currently enjoy either public attention or focus.\

The U.S. Green Building Council, a recognized authority on sustainability, defines sustainable design as design and construction that significantly reduces the negative impact of buildings on the environment and occupants. Design and construction are approached from a holistic perspective.

It is unrealistic to provide an affordable, 100% sustainable house; therefore, priorities need to be established. *Environmental Building News* suggests the following list. (Also refer to Section 6: Material Selections.)

- Save Energy
- Recycle Buildings
- Create Community
- Reduce Material Use
- Protect and Enhance the Site
- Use Low-impact Materials
- Maximize Longevity
- Save Water
- Create Healthy Buildings
- Minimize Construction Waste

So.....how does this apply to affordable housing construction?

Sustainability for Affordable Housing

Any home (or building), whether large or small, modest or luxury, can benefit from a holistic and sustainable approach to design. This philosophy does require more attention to interrelated components such as cooling/heating equipment, insulation, sealing, and window glazing; however, the result can be a home that is more energy efficient, conserves water, creates a healthier environment and brings a higher value in the market.
How can the affordable housing market benefit from sustainable concepts?

Keep in mind....."**Green" is not always seen.**

Going "green" for affordable residential design means the following areas are considered:

Site

- Infill development (already the focus of this handbook)
- Erosion control methods
- Home orientation to maximize natural benefits
- Landscaping to reduce heat islands
- Locate the home near bus lines (the downtown area is on major bus routes)

Energy and Atmosphere

- Identify and reduce energy consumption in the home
- Use a holistic design approach to evaluate energy consumption
- Specify energy efficient equipment and appliances
- Integrate natural ventilation
- Consider alternative energy systems when applicable

Materials and Resources

- Rehabilitate an existing building
- Reduce material use and waste
- Use salvaged building materials
- Use materials with high-recycled content
- Use local materials
- Avoid materials and systems that have CFC's and halons
- Provide a space for homeowner recycling
- Initiate a Construction Waste Management Program - Refer to Section 6

Indoor Environmental Quality

- Prevent molds and biological contaminants from finding a home in your home
- Control moisture and humidity
- Ventilate the home properly
- Provide a clean duct system
- Use low VOC materials - Refer to Section 6
- Do not smoke

Safeguarding Water

- Reduce water consumption
- Use water-conserving fixtures and appliances
- Provide water-efficient landscaping
- Minimize paved areas to reduce storm water runoff

Why is Sustainability important?

...because in the United States, buildings account for:

- 36% of total energy use/65% of electricity consumption
- 30% of greenhouse gas emissions
- 30% of raw materials use
- 30% of waste output/136 million tons annually
- 12% of potable water consumption

...because

- it saves money
- it increases home value

...because

- there are health and community benefits

...because

- there are long-lasting benefits to our natural resources and future generations.

Specific sustainable concepts are further elaborated in the following Sections:

Section 4: Site Considerations
Section 5: Energy Efficiency
Section 6: Material Selection
Section 7: Design Concepts

For further research, a measurable, certifiable rating system for both commercial and residential construction that promotes a holistic approach to sustainability was developed by the U.S. Green Building Council and provides excellent guidance for planning the incorporation of sustainable concepts into a building project. The program acronym is LEED™, ("Leadership in Energy & Environmental Design" Green Building Rating System).

Links and Resources

U.S. Building Council ..... www.usbgc.org

LEED™
(Leadership in Energy
and Environmental Design) .....www.usbgc.org/LEED/leed_main.asp

Southface Energy Institute ..... www.southface.org

Rocky Mountain Institute ..... www.rmi.org

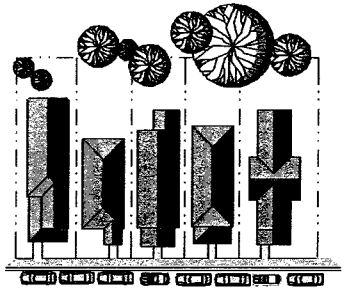
U.S. Department of Energy .....www.energy.gov

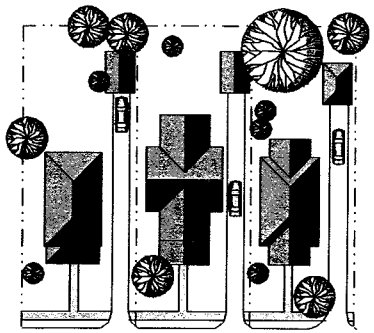
Energy Information Administration .....www.eia.doe.gov

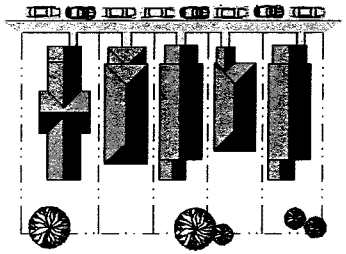
SITE CONSIDERATIONS

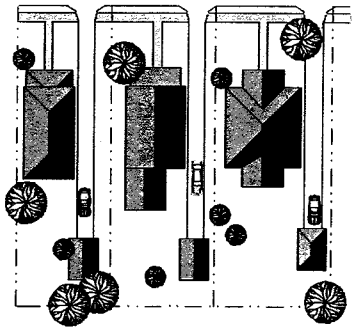
Section 4

Neighborhood Context
Site A
Site B
Site C
Checklist for Site Considerations
Links and Resources









Each site should be evaluated individually based upon a variety of factors. This document does not attempt to exhaust the variables that exist within each site condition. Only a few factors are considered here to demonstrate potential integration of zoning code, neighborhood context, and environmental conditions.

The architectural context of the neighborhoods is covered in Section 2 "Neighborhoods".

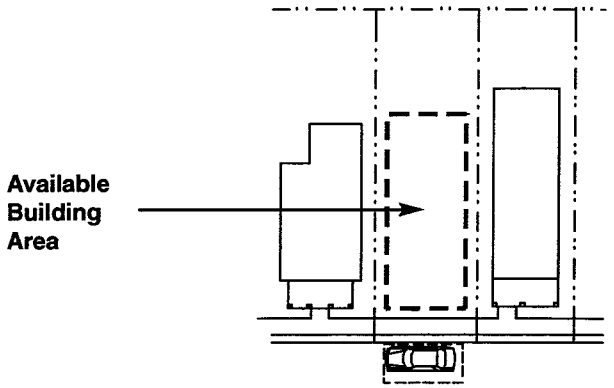
Neighborhood Context

The medium to high-density land-use zoning established in the downtown neighborhoods predetermines to some extent the major aspects of home design. The specific land use pattern is arguably more important to the unity and identity of the neighborhood than is the architectural style. The land-use pattern unites the various styles and continuity. Maintaining the existing land-use pattern is paramount to the infill construction being compatible with the neighborhood. A few important elements that establish the street rhythms and patterns are:

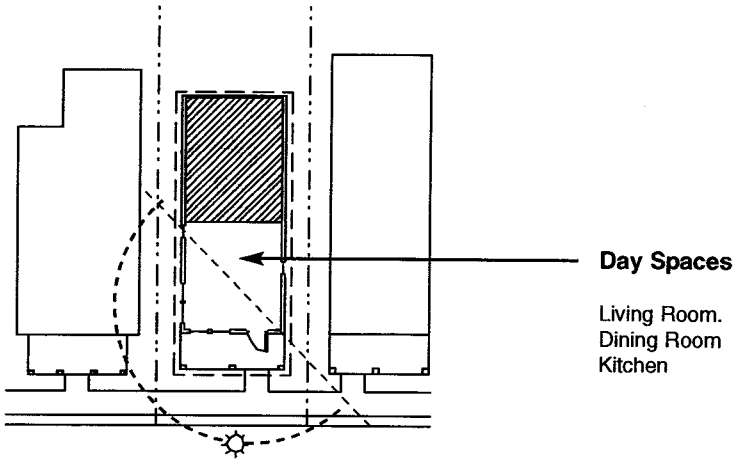
- Street type: Boulevard, main artery, site street, traffic level
- Lot size - single most significant contributor to the architectural solution in terms of density, massing, scale; and determines the street rhythm of structures
- Setbacks establish street relationship and maintain the street edge and street volume
- Parking patterns - driveways, lack of driveways, alleys with rear parking, and on-street parking
- Porches - clear point of entry and provide visual means for neighbors to visually connect with neighbors
- Trees, neighborhood parks and amenities

Many "green" site-planning strategies are difficult to implement within the density of the neighborhood. As a site grows larger and less dense, more options are available for locating and designing a home to take advantage of sun, views, and breezes and to be protected from undesirable sun, views, and noise. To illustrate this approach, three different lot configurations are shown on the following pages to offer some suggested applications within the urban context. Three basic concepts are discussed:

- Zoning issues
- Site and interior space orientation for environmental conditions
- Sustainable landscape suggestions



Sample Zoning Constraints



Environmental Orientation

- see actual zoning regulations for *specific* site requirements.

Sample Zoning Constraints

- see actual zoning regulations for *specific* site requirements.

1.	Lot Frontage	20'-34'
2.	Minimum Front Yard Setback	8' min.
		(1), (a)
4.	Minimum Side Yard Setback	3'min.
		(a), (c), (f)
5.	Minimum Reer Yard Setback	20'min,
		(a,b), (2)
6.	Maximum Building Height	14'
7.	Parking Requirements	(a,b,d,e),
		(3)
8.	Maximum FAR	.35, (5)
9.	Primary Entrance	4
10.	Transparency in Primary	10%
	Wall Plane	

a. Projecting elements, including roof overhangs, porches and/or balconies and primary entrances, shall not extend beyond the minimum setbacks. *Note: Porches over 36" in height above grade are no longer allowable projections but are considered part of the main house footprint.*
b. For properties with a dedicated alley, rear yard setback requirements shall be considered the same as front yard requirements.
c. For corner properties, the side yard facing the street shall be considered a front yard and adhere to front yard setback requirements.
d. Required parking for new infill single family dwelling shall be the same as was provided on site previously.
e. Required parking for properties with dedicated alley is a min. of (1) space per single family dwelling a max. of (2) spaces accessed from the alley. The designated parking space shall not be provided within the rear alley setback.
f. For houses over 50 feet deep, side yard setback must be increased 1" for every foot over 50 feet.

1. The required setback shall be located within the range of setbacks as illustrated and explained in the zoning definitions.
2. The minimum rear yard setback shall be 20' or 20% of lot depth up to 80' lot depth, or 25% of lot depth if the lot is deeper than 80'; whichever is greater.
3. The "designated" parking space(s) must be placed behind the front plane of the bldg.
4. The primary entrance must face the street.
5. 2,600 SF maximum building floor area permitted. Greater building area is required to meet FAR min. requirements.
6. Actual property line locations, and site conditions vary. These examples shown for demonstration purposes only.

Zoning

All planned development must comply with the LFUCG Zoning Ordinance or appear before the Board of Adjustment for review of possible variance from the regulations. Refer to the LFUCG Zoning Ordinance for more detailed information.

Environmental Orientation

Environmental orientation can provide a significant reduction on energy bills and provide natural daylighting of the interior. This document seeks to provide a modest approach to maximize natural (free) benefits of the environment while tempering the negative environmental exposures. A fully solar design is beyond the scope of this document. Key components to this environmental tempering are:

Orientation

- Try to orient the house so the longest side faces south or southeast. However, this is not always possible given the grid of the streets in Lexington.

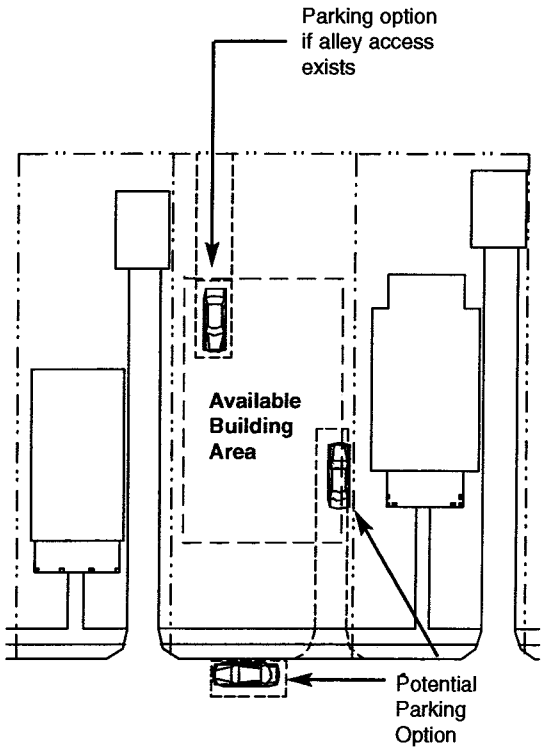
- Floor plan layout - orient day spaces such as living, dining, kitchen toward the south or southeast, when possible.

- Windows - Placement, amount, type (Refer to Section 5 for further discussion)
  - Proper shading - Admits low-angle sun in winter; stop direct sun in summer.
  - Balancing heat gain and heat loss through windows is very important - (Refer to Section 5 for further discussion)

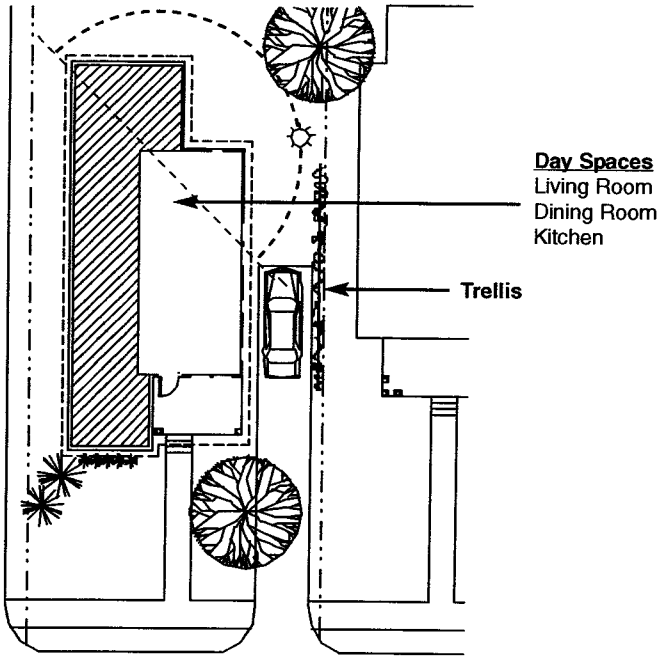
- Landscaping - (Refer to this Section - Site B & C)

- Proper ventilation - (Refer to Section 5 for further discussion)

Evaluation of other routine environmental site conditions such as soil contamination, lead base paints, asbestos, (rehab), high water table, and soil conditions etc. are beyond the scope of this document and must be evaluated on a site-by-site basis.



Sample Zoning Constraints



Landscaping Option

- see actual zoning regulations for *specific* site requirements.

Sample Zoning Constraints

-see actual zoning regulations for *specific* site requirements.

1.	Lot Frontage	35'-50'
2.	Minimum Front Yard Setback	8' min.
		(1),(a)
4.	Minimum Side Yard Setback	3'min.
		(a),(c), (f)
5.	Minimum Reer Yard Setback	20'min,
		(a,b), (2)
6.	Maximum Building Height	24'
7.	Parking Requirements	(a,b,d,e),
		(3)
8.	Maximum FAR	.35, (5)
9.	Primary Entrance	4
10.	Transparency in Primary	10%
	Wall Plane	

a. Projecting elements, including roof overhangs, porches and/or balconies and primary entrances, shall not extend beyond the minimum setbacks.
b. For properties with a dedicated alley, rear yard setback requirements shall be considered the same as front yard requirements.
c. For corner properties, the side yard facing the street shall be considered a front yard and adhere to front yard setback requirements.
d. Required parking for new infill single family dwelling shall be the same as was provided on site previously.
e. Required parking for properties with dedicated alley is a min. of (1) space per single family dwelling a max. of (2) spaces accessed from the alley. The designated parking space shall not be provided within the rear alley setback.
f. For houses over 50 feet deep, side garud setback must be increased 1" for every foot over 50 feet.

1. The required setback shall be located within the range of setbacks as illustrated and explained in the zoning definitions.
2. The minimum rear yard setback shall be 20' or 20% of lot depth up to 80' lot depth, or 25% of lot depth if the lot is deeper than 80'; whichever is greater.
3. The "designated" parking space(s) must be placed behind the front plane of the bldg.
4. The primary entrance must face the street.
5. 2,600 SF maximum building floor area permitted. Greater building area is required to meet FAR min. requirements.
6. Actual property line locations, and site conditions vary. These examples shown for demonstration purposes only.

Landscaping

A well-designed landscape can assist with:
- Reducing energy costs - 15%-50%
- Protecting your home from winter wind and summer sun
- Reducing water consumption, pesticide use, and lawn and landscape maintenance.

Trees

Trees and other vegetation prevent soil erosion, mitigate storm water runoff, and contribute to the aesthetic value of the area, thus increasing property market values.

"Air temperatures under a tree can be as much as 25 degrees cooler than air temperatures above nearby blacktop."

This shade is significant when considering the reduction of the roof's heat load.

Select and locate new trees carefully. Aesthetics are often the basis for selecting and locating trees and vegetation; however, there are very important practical considerations that should not be ignored that can add to energy efficiency and water efficiency. Identify existing trees to be preserved, and clearly mark them.

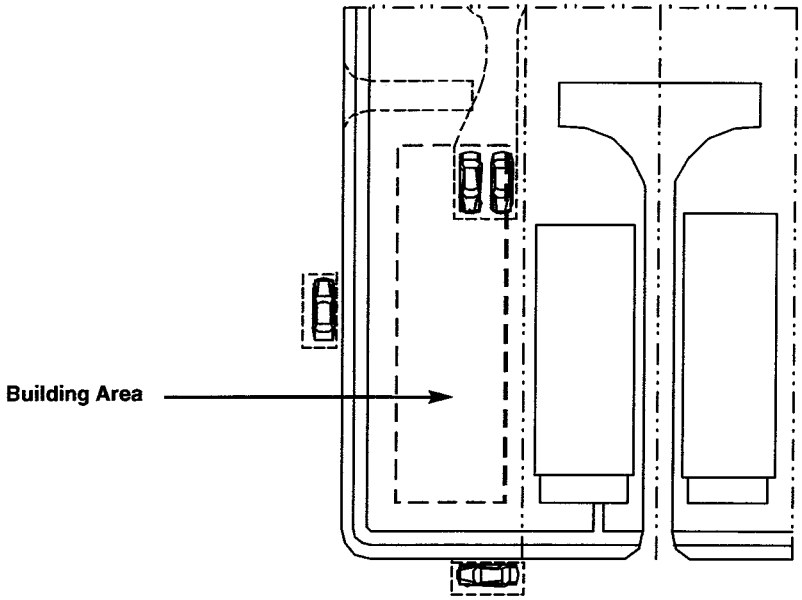
(Refer to the LFUCG Tree Protection Zoning Article No. 26, and LFUCG Planting Guide for further information)

Evergreen Trees

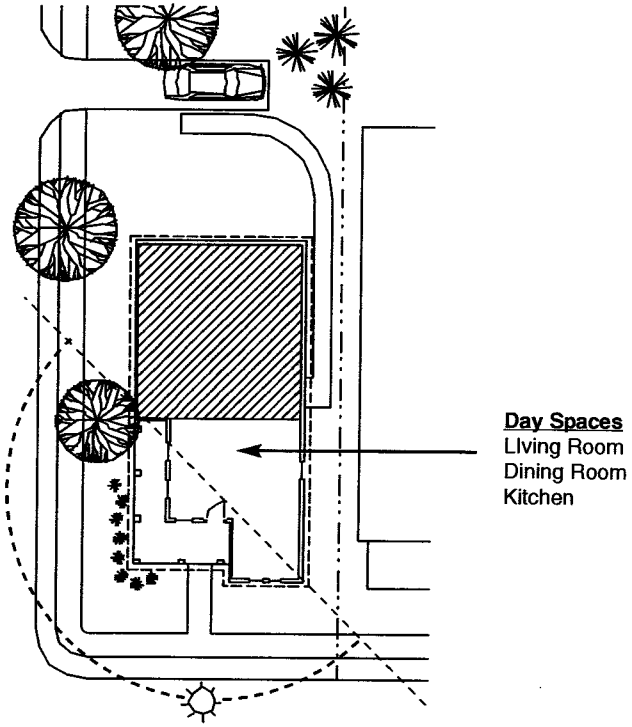
- Block wind - dense planting on the windward side of the home - typically the north or northwest side.
- Block undesirable views
- Provide some noise control

Deciduous trees

- Provide shade in summer - An 8'-0" tree costs about the same as an awning, but has additional benefits by allowing winter sun through to reduce heating and lighting. This tree can begin providing shade immediately; and a fast-growing tree can shade a significant portion of the roof within 5-10 years.
- Allow winter sun into the house for desirable heat gain
- Plant on the southeast, southwest, east, and west sides of the home. If the cost for only one tree is in the budget, try to plant it on the west or southwest side of the house.



Zoning Constraints



Landscaping

- see actual zoning regulations for *specific* site requirements.

Sample Zoning Constraints - Site C

-see actual zoning regulations for *specific* site requirements.

1.	Lot Frontage	50' or more
2.	Minimum Front Yard Setback	8' min.
		(1),(a)
4.	Minimum Side Yard Setback	5'min.
		(a),(c), (f)
5.	Minimum Reer Yard Setback	20'min,
		(a,b),(2)
6.	Maximum Building Height	28'
7.	Parking Requirements	(a,b,d,e),
		(3)
8.	Maximum FAR	.35,(5)
9.	Primary Entrance	4
10.	Transparency in Primary	10%
	Wall Plane	

a. Projecting elements, including roof overhangs, porches and/or balconies and primary entrances, shall not extend beyond the minimum setbacks.
b. For properties with a dedicated alley, rear yard setback requirements shall be considered the same as front yard requirements.
c. For corner properties, the side yard facing the street shall be considered a front yard and adhere to front yard setback requirements.
d. Required parking for new infill single family dwelling shall be the same as was provided on site previously.
e. Required parking for properties with dedicated alley is a min. of (1) space per single family dwelling a max. of (2) spaces accessed from the alley. The designated parking space shall not be provided within the rear alley setback.
f. For houses over 50 feet deep, side yard setback must be increased 1" for every foot over 50 feet.

1. The required setback shall be located within the range of setbacks as illustrated and explained in the zoning definitions.
2. The minimum rear yard setback shall be 20' or 20% of lot depth up to 80' lot depth, or 25% of lot depth if the lot is deeper than 80'; whichever is greater.
3. The "designated" parking space(s) must be placed behind the front plane of the bldg.
4. The primary entrance must face the street.
5. 2,600 SF maximum building floor area permitted. Greater building area is required to meet FAR min. requirements.
6. Actual property line locations, and site conditions vary. These examples shown for demonstration purposes only.

Vegetation

Select and locate landscape vegetation carefully. Install landscaping that does not require extensive irrigation, fertilizing, and high maintenance. Avoid "exotic" species. For example, Kentucky bluegrass is not native to the United States. Consider a native species that requires less maintenance and does not have an adverse effect on the environment in water consumption and chemical pollution.

- Ground covers and flowers
- Reduce reflected sunlight
- Reduce mowing requirements
- Absorb storm-water runoff
- Avoid annual flowers that have considerable watering requirements.
- Consider perennials and perennial wild flowers that self-sow and are drought tolerant and pest resistant

Use of trellis with vines, shrubs, and groundcovers should also be considered.

Grasses

- Native species are more likely to survive
- Buffalo grass and fescue only grow to a certain height - roughly 6 inches
- Require 1/5 the water required to support Kentucky Bluegrass or rye.

Vines and Shrubs

- Vines and shrubs can be used to shade exterior air conditioning unit, patios and walks. (or trees)
- Reduces the heat radiation around the home.
- Vines can provide shade to an area within a single growing season and allow breezes to follow through.
- Plant vines on east or west wall to reduce heat load on the house.

Checklist for Site Considerations

Planning

- ☐ Investigate zoning restrictions
- ☐ Determine if H-1 zoning applies (Historic overlay)
- ☐ Determine if the site is in a national historic district

Sitework

Erosion Control
- ☐ Limit the amount of soil disturbed on site
- ☐ Minimize borrow/fill
- ☐ Stockpile and preserve topsoil on site and protect from erosion
- ☐ Install temporary silt fencing and protect any drain inlets. Doubling and reinforcing silt fencing may be required during rainy periods.
- ☐ Many urban infill lots are relatively flat. Proper drainage away from the foundation is critical. Grade slopes minimum of 5% from foundation.
- ☐ Immediately after grading, place straw and/or sod for slope stabilization.

Paved areas
- ☐ Consider using porous paving for sidewalks and patios to allow for direct storm water infiltration.

Environmental Orientation
- ☐ In high density areas, use flexible plans and asymmetrical home styles to take advantage of limited opportunities for useful access to sun, breezes, and views.
- ☐ Orient the house so that the longest side faces south when possible
- ☐ Locate day spaces in the floor plan facing south or south east

Erosion Control
- ☐ Limit the amount of soil disturbed on site
- ☐ Minimize borrow/fill

Landscaping

Trees
- ☐ Preserve existing trees where possible
- ☐ The limbs and stump of any tree that is necessary to remove is ground and used for mulch.
- ☐ Trees that remain are clearly marked and fenced at the drip line.
- ☐ Vehicles and materials are not parked or stored within the drip line of a tree.
- ☐ Bore holes through tree root areas rather than trenching.
- ☐ Provide a retaining wall at or near the drip line where existing grade changes near an existing tree.
- ☐ If new trees are planted, properly select tree type:

Evergreen - blocks wind and sunlight throughout the year.
Deciduous - blocks sun in summer, allows light through in winter.

- ☐ Plant new shade trees on the southeast, southwest, east, and west sides of the home.
- ☐ Try to avoid planting trees on south side.
- ☐ Plant indigenous trees.
- ☐ Determine spacing by the mature size of the tree.
- ☐ Slow-growing trees generally live longer, and are more resilient to wind, drought, and snow.
- ☐ Fast-growing trees begin to shade windows in the first year and take 5-10 years to shade the roof

Vegetation
- ☐ Plant indigenous vegetation adapted to specific site soil conditions (including grass & sod) to minimize maintenance and irrigation requirements.
- ☐ Avoid dense foliage plantings close to the home if frequent watering is required because of foundation humidity concerns.
- ☐ Provide mulch at planting areas to reduce evaporation.

Irrigation
- ☐ Collect rainwater from downspouts in water reservoir to use as water for irrigation.
- ☐ Use drip irrigation hose if irrigation is required.

Links and Resources

For information regarding requirements of new infill construction, refer to the following publications:

"Guidebook for Property Owners, a guidebook to understand H-1 zoning in Lexington, Fayette County, Kentucky"
prepared by the Division of Historic Preservation.

This publication documents the different historic neighborhoods and addresses the Board of Architectural Review process.

"Design Guidelines"
prepared by the HIstoric Preservation Commission. These are the adopted zoning requirements per Article 13 of the LFUCG Zoning Code. This document provides more specific information pertaining to design principles, design context, site, rehab, and new construction.

LFUCG Zoning Ordinance

LFUCG Planting Manual

ENERGY EFFICIENCY

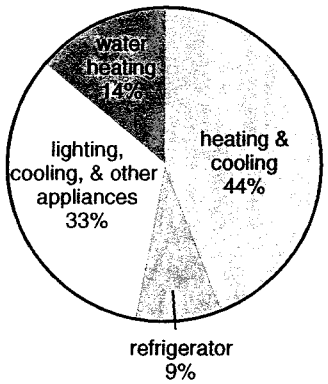
Section 5

Architectural Design
Building Envelope
Building Systems
Appliances
Checklists
Links and Resources

Energy efficient homes save the homeowner money. A few hundred dollars a year in savings can make an enormous difference in making ends meet. But in order to achieve a more efficient home, you need to know:

How is energy typically consumed in the home?

Home Energy Use



In the low-income housing market, applying no-cost or low-cost design principles can lower the energy consumption by 30-50%. Building America's systems engineering approach recognizes the interrelationship of site (maximizing natural (free) benefits from the sun) , envelope, mechanical systems and others. Rather than evaluating the initial cost/benefit of each individual component (i.e., the cooling system) independently, this system considers interrelated components together in long/short term in order to truly understand the cost/benefit of selecting one system or material over another. Savings can then be reinvested in other energy-saving items that further reduce energy consumption and costs. For example:

Energy-efficient windows cost more than standard products; however, they reduce heating and cooling needs, which reduces the size of the mechanical equipment and the energy consumed. The savings in installation cost and/or operating expenses will help offset the premium cost for better windows. In addition to saving energy, the windows reduce condensation, which enhances durability and prevents mold.

Maximizing energy efficiency involves more than installing additional insulation. Examples of systems engineering cost-saving take-offs include:
- Advanced framing system - (optimum value engineering) - refer to pg. 42)
- Tightly sealed house envelopes
- Shorter, less costly ductwork
- Smaller, less expensive mechanical systems
- Modular construction

Different technical strategies and options for energy savings such as the example above, are provided to expose organizations and builders to energy-efficient concepts. However, market and site limitations will determine the practicality and cost-effectiveness of integrating specific design options.

This Section is divided into four different interrelated subject areas:

Architectural Design
Building Envelope
Building Systems
Appliances

Architectural Design

Efficient Floor Plans

The primary way to make a more efficient floor plan layout is...

...to build less space

...less space; less cost.

"Efficient floor planning is perhaps the single most important sustainable building practice available - and the easiest step to take.

Southface Energy Institute.

Southface Energy Institute offers the following considerations for generating an efficient layout:

- Orient buildings (rooms) and windows for passive heating, cooling, and daylighting. Careful selection, sizing, and location of windows and light wells can flood a small space with natural light without increasing energy use.
- Share space between different uses.
- Use the entire volume. Keep usable space from being lost.
- Reduce circulation paths. Shorten or eliminate hallways.
- Build furniture into rooms. Cabinets, bookcases, benches, and eating nooks use less space when they become part of the structure.
- Remove formal spaces. Most people gather in kitchen and family rooms.
- Reduce bedroom size. Most people use bedrooms primarily for sleeping, dressing, and little more.
- Provide ample storage.
- Instead of building a wall to separate spaces, change floor coverings, expose a beam or hang a pot rack.
- Plan for flexibility. The design should allow for changes in lifestyle. 4

Environmental Orientation

"Proper building orientation can reduce home energy use at little or no cost. Southface Energy Institute

This document seeks to provide a modest approach to maximize natural (free) benefits of the environment while tempering the negative environmental exposures. A fully solar design is beyond the scope of this document. Key components include:

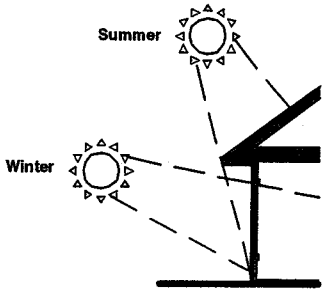
- Floor plan orientation & layout
- Proper shading
- Windows
- Landscaping - (Refer to Section 4 - Site Considerations, Site B & C)
- Proper ventilation - (Refer to this Section)

If possible, orient the house so the longest side faces south or southeast. This is not always possible given the grid of the streets in Lexington, but try to minimize east and west exposures.

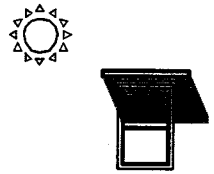
Place day-use spaces such as living rooms, dining rooms, and kitchens on the south side or southeast side when possible.

Place porches on the east and west side to provide shading when possible. Develop asymmetrical floor plan models - this will provide more flexibility in making adjustments for different site solar orientations.

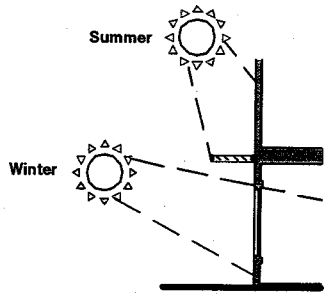
Shading
Shading strategies work because the angle of the sun is higher in summer and lower in winter. Therefore, shading devices are designed to block summer sun (undesirable heat gain) and allow winter sun into the house (desirable heat gain). Exterior shading devises are more effective than interior blinds because the sunlight is blocked before it enters the windows. The south facing glass must be shaded properly, and west-facing glass should be minimized. Refer to the diagram for a shading design guideline.



Roof overhangs are an extension of the roof beyond the wall surface. They require no operation by the homeowner to work properly.
The closer to the floor a window is located, the longer the overhang needs to be. The length can range from 2-4 feet in this part of the country, with 2 feet being the most common.



Extend fixed overhang past window



Fixed louvers reflect summer sun but allow winter sun in

Awnings can block as much as 65% of sunlight in the summer on south-facing windows and as much as 77% on east facing windows. However, they also prevent the heat gain from the winter sun from entering and can block views. Design rule of thumb: provide a drop of 65% - 75% of window height on east windows and a drop of 45% - 60% of window height on south windows. (Make sure the bottom of awning is a min. of 6'-8" above walking surface) Maintaining a small gap between the awning and the house wall allows the hot air that accumulates under the awning to vent.

Windows
Providing proper amounts of glass on all exposures is important to balancing heat gain/loss, natural ventilation, and desired views. Refer to the table for general recommendations.

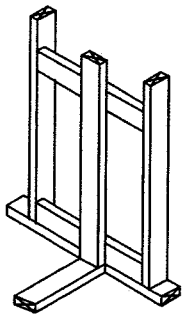
Approximate Recommended Non-south Glass Guidelines

Orientation	Percent of Total Floor Area
North	4%
South	4%
East	2%
West	2%

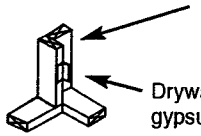
However, due to given lot constraints of urban infill, the actual window placement is going to be a balance of energy efficiency and other factors such as street orientation and views.

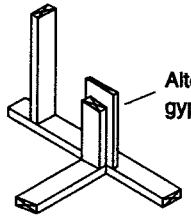
Specify energy efficient windows and doors. (Refer to Section 6 Material Selection Checklist)

Skylights are not recommended due to seasonal overheating, radiant heat loss, and other maintenance issues.



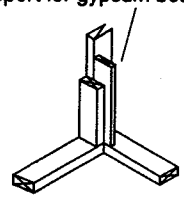
Adopting the OVE framing technique reduces wood waste, increases structural efficiency and promotes thermally efficient walls.





Alternative 1x6 vertical support for gypsum board

1x4 support for gypsum board.



Building Envelope

Advanced Framing Systems

The U.S. Forestry Products Association and other organizations have devised a framing system using optimum value engineering (O.V.E.). This system reduces the amount of material used for framing while maintaining structural integrity. This system saves material and labor costs. Key framing components include:

- 2 x 4 stud framing on 24" centers rather than the typical 16" centers. (used by Habitat for this temperature region - will vary by location/climate)
- Design the house on a 24" module to reduce waste and cutting
- Less corner framing by using interior drywall clips
- Ladder T-wall framing at intersections with interior wall
- More energy efficient headers
- Eliminating curtailed studs (cripples)
- Single top plates via point loading - aligning roof framing and wall framing
- Align doors and windows within the 24" grid

Advantages include:

- Elimination of insulation voids
- More wall insulation
- Thermal bridging is reduced
- More space for insulating around electrical and mechanical penetrations

Disadvantages include:

- The interior wallboard and/or exterior siding may bow slightly between studs
- Additional framing at door and window jambs still required.
- Full insulation advantage will depend on amount of window openings - if the windows are more than 10% of the total wall, the economics need to be closely evaluated.

Optimum range of eaves widths for value-engineered roof design

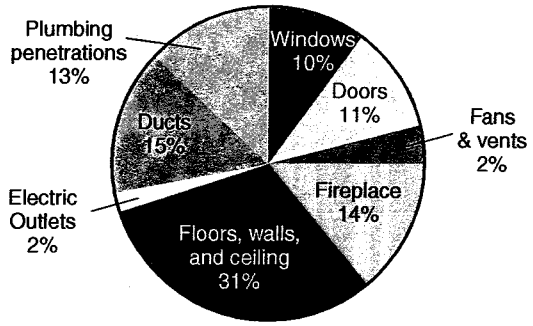
House Width (in feet)	Roof Pitch					
	4:12	5:12	6:12	7:12	8:12	9:12
22	less than 4" or 16" - 24"	12" - 20"	8" - 16"	4" - 12"	4" - 6" or 20" - 24"	12" - 20"
24	4" - 12"		4" - 8" or 24"	12" - 20"	6" - 12"	4" - 8"or 16" - 20"
26	16" - 24"	12" - 20"	8" - 12"	4" - 8"	16" - 20"	8" - 16"
28	4" - 12"	4" - 8" or 24"	16" - 24"	12" - 16"	4" - 8" or 24"	4" or 16" - 20"
30	16" - 24"	12" - 16"	4" - 12"	4" - 6" or 20" - 24"	12" - 16"	4" - 12" or 24"
32	4" - 12"	4" - 6" or 20" - 24"	12" - 20"	6" - 12"	4" - 6" or 20" - 24"	12" - 16"

HFH - Material Management Program Manual

Create a "tight" house

Create a continuous air barrier around the envelope. The envelope is the floor, exterior walls, and ceiling that separate conditioned space from unconditioned space (refer to attached checklist). Air leakage can account for over 50% of a home's heating and cooling costs, and contribute to problems with moisture. Common sheating materials can accomplish this. However, gaps and holes cut into these materials are often unseen and left unsealed. Filling these gaps can be accomplished with very inexpensive materials. Cost is not the problem. Sealing and caulking throughout all phases of the construction process is very difficult. Identify the problem areas during the planning phase and assign responsibility for who and how it will be accomplished.

How Does the Air Escape?

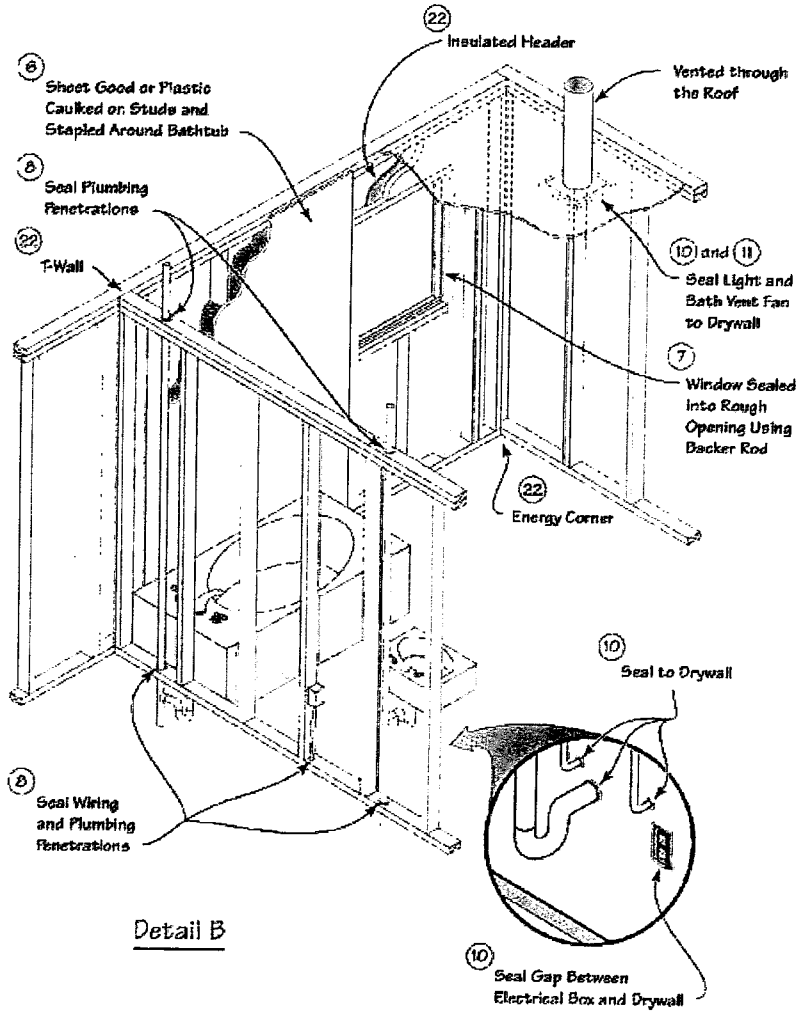


- Note that a minimum level of ventilation (outdoor air) controlled through the mechanical unit is required for a healthy indoor environment. (refer to heating and cooling section)

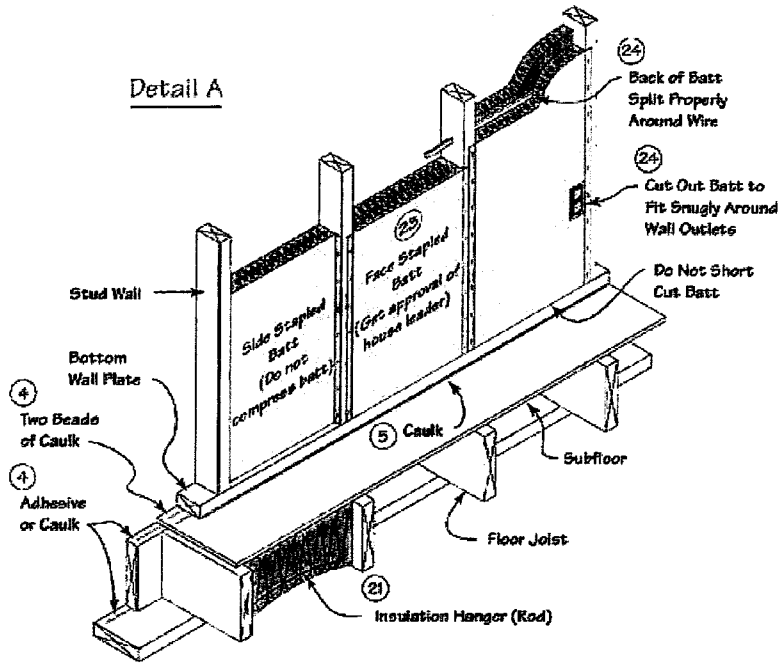
- Note that loose and fiber insulation products do not seal against air leakage.

Build America and Habitat for Humanity Green Team uses polyisocyanurate rigid foam sheathing on the house exterior and OSB sheathing. The insulation board is foil faced and its joints are taped and caulked so that it acts as an exterior air barrier as well as a drainage plane for rain control. Building paper or house wrap is eliminated. Metal "T" let-in bracing notched into wall studs is also used to provide the structural support provided by typical plywood or OSB sheathing.

Lexington Habitat for Humanity builds with 2 x 4 framing. Other regions may choose 2 x 6 framing depending on climatic factors.



Detail B



Create continuous insulation barriers

Insulation reduces heat flow through the envelope - measured by R-value. The higher the R-value, the greater the insulating value. Consult the Model Energy Code (MEC) for recommended values. Gaps in insulation waste energy and can lead to condensation that can damage building materials and cause growth of molds, dust mites, and other biological contaminants.

Many homes experience mold growth at the junction of the ceiling and exterior walls. The cause of the mold is often too little attic insulation at the eave. Warm room air hits the cold ceiling and moisture condenses in the drywall. The damp drywall is an ideal environment for mold growth. 7

Prevent interior moisture buildup with controlled ventilation. (Refer to Heating and Cooling in this Section)

When it is hot outside, occupants want to be cool
When it is cold outside, occupants want to be warm

Heating and Cooling Systems

The energy consumption graph on page 35 clearly shows that the majority energy consumption is used in heating or cooling, and a remaining 33% will have a direct effect on the heating and cooling requirements.

There are a variety of systems available to keep the occupants comfortable. This section will discuss the following systems:

Natural Ventilation
Passive Solar (discussed previously)
Combustion Furnace and Air Conditioning System
Heat Pump (air-source)
Heat Pump (geothermal or ground-source)
Photovoltaic

Natural Ventilation

Incorporating both natural and mechanical means of heating and cooling will maximize energy effectiveness. The roof, walls, and windows are the primary sources of heat load. Many techniques can be used to reduce the home's energy demand (or load) without specific consideration of a mechanical heating and cooling system.

Natural ventilation is designed to allow built-up heat inside the house to be ventilated out. This only works when the inside temperature is higher than the outside temperature. Therefore, only ventilate during cool parts of the day, morning and evening. When possible, take advantage of the prevailing winds to assist in natural ventilation.

Ceiling Fan Sizes

Largest Room Dimension	Minimum Fan Dimension (inches)
12 feet or less	36
12-16 feet	48
16-17.5 feet	52
17.5-18.5 feet	56
18.5 or more feet	2 fans

Install ceiling fans. Moving air makes you feel cooler and can lower the perceived air temperature as much as 4 degrees.

A minimum clearance of 10" is required between the typical 8'-0" ceiling and the fan to assure proper ventilation. For taller ceilings, the fan blades should be mounted about 8'-0" above the floor.

To encourage whole house ventilation, open a window in the lowest part of the house and a window on the opposite side on the highest level of the house. This natural "ventilation" can also be accomplished with clerestory windows.

Minimize sources of interior heat gain when possible. Some of these sources include lighting; appliances such as ovens, dishwashers, and dryers; and human activity.

- Avoid using appliances during the hottest part of the day.
- Utilize natural daylighting in lieu of electric lights.
- Purchase energy efficient lighting.
- Consider using the microwave or an outdoor grill during very hot periods.
- Purchase energy efficient appliances.

General Consideration for a Heating and Cooling System

Make the home and envelope as energy efficient as possible (Discussed previously in this Section.)

- Properly size the system. Do not use rules of thumb. Do not oversize the system. Bigger is not better. Energy efficiency is greatly reduced by constant on/off cycling of cooling equipment. Oversized cooling equipment may also contribute to moisture problems.
- Consider all building attributes such as natural ventilation, passive solar strategies, load reductions, ceiling fans, and others when sizing the system
- Install air handler and ducts in conditioned space when possible.
- Do not install ducts in exterior walls.
- Minimal use of flex duct
- Insulate ducts to R-8 (do not use internally lined/insulated ductwork due to air quality problems)
- Install outside air intake with damper
- Locate the outdoor unit on the north side of the house, if possible, or in a shady location.
- Specify air leakage less than 10% of airflow min.
- Do not use building cavities as ducts.
- Seal duct joints with mastic.
- Reduce duct runs. (If the envelope is well insulated and "tight", extending ducts to perimeter isn't always necessary).
- The lowest bid is not always the best value. Consider the quality of the equipment and reputation of the contractor.
- Do not block supply diffusers/return air grills.
- Provide easy access for coils and filters.
- Clean/replace filters every 2-6 months min.
- Remove plants/debris from around the outdoor unit
- Regular maintenance - a preventative maintenance contract with a reputable contractor is a good investment.
- Duct sealing - average U.S. homes lose 25% of heating energy through leaky ducts.
- Thermostat - install set-back or programmable thermostat and instruct homeowner on its operations.

Combustion Furnace with Central Air Conditioning

One of the most commonly occurring mechanical systems in this region is the gas furnace/split system.

Efficiency Recommendation		
Product Type	Recommended AFUE [a,b]	Best Available AFUE
Residential Gas Furnace [c]	90% or more	97%

[a] AFUE (annual fuel utilization efficiency) is a measure of heating efficiency on an annual basis. The DOE test procedure defines AFUE as the heat transferred to the conditioned space divided by the fuel energy supplied.

[b] Based on DOE test procedure, see 10 CFR, Sub-Part B, Appendix N.

[c] Residential gas furnaces include those fired by natural or propane gas, with input ratings less than 225,000 Btu/hour.

Furnace efficiency is measured by annual fuel utilization efficiency (AFUE). There may be restrictions regarding proximity to door and window openings for condensing furnaces.
Do not oversize the air conditioning unit. Oversizing can cost more, is not energy efficient, and can create humidity problems. Over-sized units cycle off before the humidity is adequately removed.

Air-Source Heat Pump
Another commonly occurring mechanical system in this region is the DX-Split System or packaged air-source heat pump. A heat pump system heats and cools the home in a single system. In the DX-Split System, the air handler is located insideand the condensing unit is outside. In the packaged unit, both are together outside, are located outside and ducted to the inside. If electricity is the only fuel source, this system should be considered. Some heat pumps have piggy-back systems when outside temperatures fall below the stand - alone system.

Ground-Source Heat Pump (geothermal)
The ground-source heat pump works in a similar way to the common air-source heat pump except that the heat source/sink is the ground. The efficiency of a ground-source heat pump is significantly higher than a standard heat pump because the heat source is warmer in winter and the sink is cooler in summer. These systems are most attractive in mixed climates requiring significant heating and cooling phases.
- High efficiency - significantly higher than a standard heat pump
- The system is complex.
- Installation cost of this system is high.
- Vertical loop system mitigates land space requirements.

Radiant Floor System
A radiant floor system uses water-filled pipe to distribute heat throughout the space. This pipe is located in the floor system and is the most economical with a slab-on-grade floor system.
- The system has an even distribution of heat
- Skilled design and installation required
- Integration with concrete slab is more economical than a thin-plate application

Active Solar: Photovoltaics
Photovoltaic technology is the conversion of sunlight to electricity. The process is simple, low maintenance and utilizes free solar energy. This system is most cost-effective in small, remote locations. The cost of this system in areas that are already connected to the electric grid or other fuel sources may prove cost prohibitive.

Controls
Consider installing a programmable thermostat. The thermostat is relatively inexpensive and can increase performance. Programmable thermostats are available for most central heating/cooling systems. Programmable thermostats are also available that are specifically designed for heat pumps.

Mechanical Ventilation - (refer to Section 6 Material Selection)

Plumbing
- Avoid plumbing fixtures on exterior wall
- Locate as close as possible to the bathroom
- Use low-flow fixtures
- Avoid installation of water lines under concrete slabs
- Insulate the hot water tank and lines
- Set water heater at 120 degrees

Typical Indoor Household Water Use *

Type of Use	Daily Use (gallons per person)	Approximate % of Total Indoor Use
Toilets	20.1	27.7
Clothes Washers	15.1	20.9
Showers	12.6	17.3
Faucets	11.1	15.3
Leaks	10.0	13.8
Other	1.5	2.1
Baths	1.2	1.6
Dishwashers	1.0	1.3
Total	**72.6**	**100.0**

Source: Water Miser, 1999 American Water Works * 1999

Note: This table does not include residential water use outside the home, which brings the typical total to about 105 gallons per person per day. Typical residential water consumption for lawns, gardens, and car washing is highly variable across the

Lighting Systems
Lighting accounts for 20%-25% of all electricity consumed in the United States. In the average home, 5%-10% of the energy used is for lighting.

General Considerations:
- Locate energy-efficient lighting in areas of continuous use.
- Reduce light levels where there are no visual tasks.
- Provide minimum ambient light levels for safety and security.
- Increase efficiency of fixtures and lamps.
- Use daylighting where possible and practical without incurring unwanted heat gain.
- Maintain the lighting system.

Fluorescent Lighting Guidelines

Type of Room	Size of Room	Amount of Light Needed (Watts)
Living Room, Bedroom, Family Room, or Recreation Room	under 150 sf 150-250 sf over 150 sf	40-60 60-80 .33Watts/sf
Kitchen, Laundry, or Workshop	75 sf 75-120 sf over 120 sf	55-70 60-80 .75Watts/sf

Fixtures/Lamps
- Do not use or minimize the use of incandescent lamps - inexpensive to buy ; inefficient and expensive to operate.
- Use tube fluorescent for generally lighting purposes. Electronic ballast eliminates hum and flicker.
- Compact Fluorescent - high initial cost - most energy efficient available.

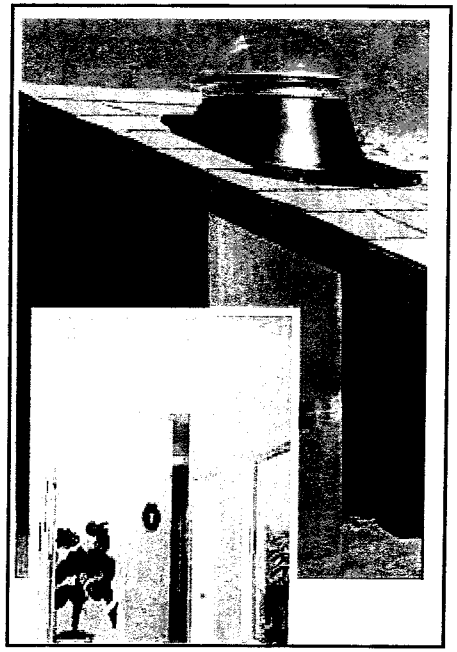
Controls

Switch the lights off when not in use

- Motion detector or Photocells - use to control exterior safety/security lighting.
- For the front or rear of the propertry. Avoid using in sideyards adjacent to other homes.
- Dimmers - provide dimmers for living, dining, and kitchen areas. They are compatible with most types of lighting including many fluorescent lamps.
- 50% or more of the electricity used in the house is wasted due to inadequate maintenance or inefficient use.
- Dust / clean the fixtures every 6-24 months. (Never clean a bulb when it is turned on)
- Clean / Replace lenses if they appear yellow.

Daylighting
Utilizing sunlight to assist in lighting the home during the day is called daylighting or natural lighting. Buildings designed for daylighting use 40%-60% less electricity for lighting. It is an ideal way to provide light while reducing operating costs.

- To properly daylight a room, at least 5% of the room floor area is required for glazing.
- Use low-E glazing coating to reduce glare, and heat transfer.
- Skylights are not recommended due to seasonal overheating, radiant heat loss, and other maintenance issues
- Consider light pipes in lieu of skylights. (Refer to Page 59 - Glass & Glazing)



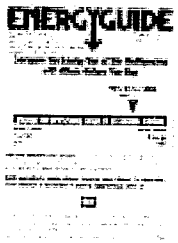
Energy Star
This label may be familiar from Energy Star labeled appliances. This is a program sponsored by the U.S. Department of Energy and the U.S. Environmental Protection Agency that requires that homes be at least 30% more efficient than the national Model Energy Code requires. A home energy rater must certify this standard. Refer to attached form.

Energy Audit
Many services and programs are available to review plans and systems. Modifications can be made at the planning stage that will save money. For example, proper orientation of the house and major spaces, sizing of mechanical equipment, location/size/type of windows, etc., to show cost benefit of these modifications.

Appliances

Purchase and install high efficiency appliances. Energy Star label is available on most appliances including TVs and home office equipment.

Refrigerator
The refrigerator should be an energy priority.
This single appliance uses as much as 9% of the total home energy consumption. (Refer to graph on page 35.



Side-by-side models, ice makers, and water dispensers typically reduce energy efficiency

Dishwasher
Efficient dishwashers save energy and water.
Look for the following features:
Booster heater
Light, medium, and heavy cycle options
Energy saving "air dry" or "no heat dry" in lieu of hot dry cycle

Washer & Dryers
Horizontal axis washer use less water and detergent and are more energy efficient. Clothes leave the washer much dryer, therefore saving energy during the drying cycle. Dryers that have energy-saving switches and humidity detectors

Stoves & Ovens
Convection ovens are 33% more efficient than standard ovens.
Gas ovens are typically more expensive to purchase but cheaper to operate
Cooktops with induction elements are the most efficient electronic cooktop.

Architectural Design
- ☐ Create an efficient floor plan layout.
- ☐ Floor plan developed on 24" grid.
- ☐ Centrally locate mechanical closet.
- ☐ Locate plumbing on interior walls.
- ☐ Locate hot water heater near use areas, i.e., bathroom, washing machine, and kitchen.

Environmental Orientation
- ☐ Orient the house for long side running east / west.
- ☐ Primary day spaces oriented to south or southeast.
- ☐ Shading of south-facing windows.
- ☐ Overhangs.
- ☐ Horizontal sun shade.
- ☐ Awnings.
- ☐ Provide a gap between the awning and the house.
- ☐ Consideration of overhang depth for shading.
- ☐ Minimize east and west windows.

Foundation
- ☐ Grade slopes minimum of 5% from foundation.
- ☐ Install 4" gravel bed below slab-on-grade floors - 1" rock gravel.
- ☐ Install a puncture resistant poly vapor barrier beneath the slab, but over gravel.
- ☐ Install 6 mil plastic ground cover in crawl space: overlap and seal seams (if constructed with crawl space).
- ☐ Provide a water stop between the footing and foundation wall.
- ☐ Provide radon ventilation if applicable.

Framing
- ☐ Optimum Value Engineering - Framing System - refer to Section 5 Energy Efficiency, Envelope.

Windows
- ☐ Specify energy-efficient windows and doors - refer to Section 5 Energy Efficiency.

Insulation
- ☐ Use insulation hangers (rods) placed every 12 inches to hold floor insulation in place.
- ☐ Use energy efficient framing (e.g., energy corners, T-walls, insulated headers) to improve coverage.
- ☐ Carefully staple kraft paper facing of wall insulation batts to side of stud or front (preferred) to avoid compressing batts.
- ☐ Cut wall insulation batts to fit around wiring wall outlets, and plumbing.
- ☐ Install soffit dams and rafter baffles to provide clearance for soffit ventilation.
- ☐ Insulate attic access hatch cover or construct cover for attic stairs from rigid foam insulation.

Sheathing
- ☐ Repair and replace any deficiencies in the rigid foam insulation.
- ☐ Tape or caulk sheathing seams or install housewrap.
- ☐ Cover and seal housewrap to top and bottom plates and sills.
- ☐ Overlap and caulk or tape seams.
- ☐ Seal all cuts and openings.
- ☐ Use plastic capped nails and staples to mechanically hold housewrap to house.

Creating Continuous Air Barrier

Before drywall is installed:
- ☐ Seal all holes in the slab to prevent entry of water vapor and soil gas.
- ☐ Seal bottom plate of exterior wall during construction.
- ☐ Seal inside edge of bottom plate after exterior walls are erected air seal behind bathtub before setting and after insulation is installed using plastic, drywall, or other sheet material.
- ☐ Seal windows and exterior doors into rough opening using spray foam or properly sized backer rod (recommended).
- ☐ Seal wiring, plumbing and HVAC penetrations at top and bottom plates, ceiling, and floors.

After drywall is installed:
- ☐ Seal bathtub drain penetration after installation and before floor insulation installed.
- ☐ Seal plumbing pipes and electrical boxes (e.g., receptacles, switches, lights, and circuit breakers box) to drywall.
- ☐ Seal bathroom ventilation fan to drywall.
- ☐ Seal attic bypasses and chases (e.g. open partition walls, dropped ceilings, and duct and flute chases).
- ☐ Caulk, glue or gasket drywall.
- ☐ Seal duct boots to floor or drywall.
- ☐ Verify that the HVAC contractor has sealed return and supply duct connections (mastic required).
- ☐ Seal exterior penetrations (e.g. porch light fixtures, outside outlets, and phone and electric service holes).
- ☐ Weatherstrip attic access hatch cover.

Moisture Control
- ☐ Install drainage board for below-grade walls.
- ☐ Backprime all exterior wood for added durability.
- ☐ Consider installing siding on a 3/8" thick stripping to create an airspace between the siding and the wall sheathing.
- ☐ Configure and install a housewrap that is designed to allow for infiltration and drainage (if housewrap is used). This saves energy and help control moisture.
- ☐ Prevent interior moisture buildup with controlled ventilation.
- ☐ Properly flash all exterior openings to prevent moisture intrusion.

Heating/Cooling/Ventilating

General Considerations - Refer to in Section 5 Heating and Cooling.

Air Conditioning
- ☐ Properly size the unit including such factors as natural ventilation and orientation, shading, landscaping, and ceiling fans in calculations.
- ☐ Perform Manual J, Load Calculation for Residential Winter and Summer Air Conditioning and Manual S to assist in calculations for proper sizing. Published by Air Conditioning Contractors of America.
- ☐ Shade the exterior condenser for improved performance.
- ☐ Select Energy Star units
- ☐ SEER (Seasonal Energy Efficiency Ratio) of at least 12, 14 if possible.
- ☐ Select units that do not use have ozone depleting refrigerant

Gas-fired equipment
- ☐ Select energy efficient model - refer to table on page 41 for gas-fired furnace.
- ☐ Provide proper ventilation
- ☐ Follow the manufacturers installation instructions and the requirements of applicable mechanical code for combustion air.

Air Source Heat Pump

Efficiency recommendations:
- ☐ HSPF (heating seasonal performance factor) 7-10, the larger the number, the greater efficiency.
- ☐ SEER (seasonal energy efficiency ratio) 12, 14 if possible.
- ☐ Typically, the higher the SEER, the higher the initial cost,
- ☐ Energy-Star label is available

Ventilation
- ☐ Incorporate soffit and ridge or gable end vents at a minimum.
- ☐ Duct range hood exhaust to outside
- ☐ Duct bathroom exhaust to outside
- ☐ Insure that combustion appliances are properly vented. Backdrafting in tightly sealed homes can be a problem.
- ☐ Install carbon monoxide detectors.
- ☐ Whole house fan with dampered outside duct for fresh air intake.
- ☐ Spot ventilation - upgrade centrally located bathroom or kitchen exhaust fan with a high quality, long-life, quiet exhaust fan. Doors are undercut and outside inlet provided.

Ductwork
- ☐ Duct leakage constitutes 10%-30% for heating and cooling loads. Duct leakage can also contribute to poor air quality.
- ☐ Use only high quality caulking or foam sealant and duct-sealing water-based mastic with fiberglass mesh. (Highly preferred)
- ☐ Never use duct tape, unrated aluminum tape (UL-181 min.) or similar products that will not provide an air-tight seal over the life of the system.
- ☐ In energy-efficient "tight" houses, it is not necessary to place registers on the outside walls or under or above windows to maintain occupant comfort, as is traditional practice.
- ☐ Locate all ducts in conditioned space.
- ☐ Insulate ductwork, min. R-6. Do not use internally lined ductwork, as it can be a collection point for mold growth and other contaminants.
- ☐ Insulation does not stop air leaks. Seal duct, then insulate.
- ☐ Minimize use of flex-duct due to higher pressure losses. Make sure that the flex-duct is not damaged during/after installation.
- ☐ Locate intake ducts away from exhausts such as laundry, kitchen, chimney, or outside automobiles or garbage areas.
- ☐ Assure the ductwork is free of dirt and debris upon start-up.
- ☐ Cover and tape registers and grilles during construction to keep ductwork clean.
- ☐ Avoid using the mechanical system during construction when possible.
- ☐ Test the airtightness of ductwork after installation.
- ☐ Design and install ductwork and filters properly

Plumbing
- ☐ Specify high-quality, water-saving faucets and fixtures.
- ☐ Use quality piping, fittings, valves, and other hardware. Leaks are damaging and costly. Consider NSF-approved fixtures.
- ☐ American Water Works Association suggests an easy "zero read" test to check for leaks.

Lighting

Refer to Section 5 Lighting

Appliances

- ☐ Specify Energy Star refrigerators and appliances. Refer to Section 5 Appliances for more considerations.
- ☐ Provide adequate ventilation to the sides and above the refrigerator to expel heat from coils.

Water heater

- ☐ Install energy-efficient water heating - typically, the higher the EF (Energy Factor), the more efficient.
- ☐ Gas-fired heaters generally cost more than electric to purchase but cost less to operate.
- ☐ Size correctly to meet demand.
- ☐ Insulate water heater with jacket - R-16 - do not cover the relief or drain valve or the air inlet to the burner (gas only).
- ☐ Install heat traps (check valve or inverted loop) on both hot and cold water pipes
- ☐ Insulate first 4'-0" of all hot & cold water piping - R-6
- ☐ Insulate water pipes in crawl space for freeze protection
- ☐ Consider alternative hot water heating, i.e., solar, heat pumps, heat recovery.

General
Ask an Expert - DOEs provides free
general & technical assistance .....E-mail: doe.erec@nciinc.com
Energy Star .....www.energystar.gov/homes
Southface Energy Institute .....www.southface.org
Rocky Mountain Institute .....www.rmi.org
U.S. Department of Energy (DOE) .....www.energy.gov/
Energy Information Administration .....www.eia.doe.gov/
Building America .....www.eere.energy.gov/
building_america/
Optimum Value Engineering .....www.nahbrc.org

Heat Pumps
Too/Base Hotline NAHB Research Center .....
DOE's - Consumer Energy
Information Web site .....www.eren.doe.gov/consumerinfo/
DOE's Energy Efficiency and Renewable
Energy Network (EREN) .....www.eren.doe.gov
DOE's office of
Bldg. Technology .....www.eren.doe.gov/buildings/
ee_heatpump.html
Air Conditioning and Refrigeration Institute (ARI) .....www.ari.org/
Consortium for Energy Efficiency (CEE) .....www.ceeformt.org/
Eastern Heating & Cooling Council (EH-CC) .....www.eh-cc.org/
The Energy Outlet .....www.energyoutlet.com/
res/heatpump/
International Energy Agency
Heat Pump Centre .....www.heatpumpcentre.org/

Geothermal Heat Pumps
Geothermal Heat Pumps Make
Sense for Homeowners. .....www.eren.doe.gov/erec/factsheets
/ghp_homeowners.html
DOE Office of Geothermal Technologies, 1998 .....www.eren.doe.gov/
geothermal/pdf/26161b.pdf

Passive Solar Design
DOE's Fact Sheet for Passive
Solar Design for Your Home .....www.ere.energy.gov
/erec/factsheets/coolhome.html
Sustainable Building Industry Council (SBIC) .....(202) 628-7400 - phone
(202) 393-5043 - fax
E-mail: sbic@sbicouncil.org
Florida Solar Energy Center (FSEC) .....(407) 638-1000 - phone
Provides technical services and
information for hot and humid climates .....(407) 638-1010 - fax
.....E-mail: webmaster@fsec.ucf.edu

Lighting
DOE's Lighting Fact Sheet .....www.eere.energy.gov/
factsheets/eelight.html
Illuminating Engineering Society
of North America (IESNA)
120 Wall Street, 17th Floor .....phone (212) 248-5000
New York, NY 10005 .....fax (212) 248-5017

"Getting the Most From Your Lighting Dollar"
A publication issue by The National Lighting Bureau (NLB) Advanced Lighting Guidelines: 1993, U.S. Department of Energy Available through National Technical Information Service

"Energy-Efficient Lighting for the Home,"
Home Energy, pp. 53-60 November/December

"Fluorescent Lamps - A Bright New Recyclable,"
Resource Recycling, pp. 71-78, March 1992

Daylighting
Windows and Daylighting Group
Lawrence Berkeley National Laboratory
Mail Stop 90311, Building 90, Room 3026
1 Cyclotron Road .....phone (510) 486-6845
Berkeley, CA 94720 .....fax (510) 486-4089
(one of America's foremost authorities on daylighting)

Concepts and Practices of Architectural Daylighting
F. Moore Van Nostrand Reinhold Co., 1991

"Energy-Efficient Lighting, Naturally,"
Popular Science, ...
pp.44-47, August 1990 .....
.....

Appliances
DOE's Top Rated
Energy Efficient Appliances .....www.aceee.org/consumerguide/
2000enef.htm
DOE's Why Buy
Energy-Efficient Appliances? .....www.eren.doe.gov/buildings/
consumer_information/

MATERIAL SELECTION

Section 6

Materials Priorities
Sustainability
Indoor Air Quality
Durability
Waste Reduction
Materials Checklist
Links and Resources

Materials Properties

Selecting quality materials can be a difficult task. Specifying materials for the cost-conscious affordable housing market is even more difficult. Every dollar has to count when considering the many choices of materials and systems available. In the for-profit realm, "time is money". Labor costs are the most significant issue of job-site management. However, in the non-profit arena, most labor is donated, and so managing the use of materials wisely is the significant key to overall cost reduction. Therefore, priority should be given to material selection. Allocate available dollars for items that provide the most significant and durable benefit. These typically involve the building envelope and systems. Consider the following list of priorities.

Health and Safety - Homeowner and Construction crew
Durability and Low Maintenance
Energy Efficiency - refer to Section 5
Cost
Neighborhood Compatibility - refer to Section 2
Environmental Considerations - refer to Sections 4 & 5

On the Checklist following this narrative, standard building products are included but the focus of this Section is specifically related to educating organizations and builders about available sustainable systems and products and how they can apply to the affordable housing market.

Sustainability

It is unrealistic to provide 100% sustainable products and materials for a house. However, environmentally improved products should be utilized whenever practical. It is anticipated that the availability and affordability will continue to increase over time. Determining what sustainable products or systems to include in a house should be based upon the above priority list.

In order to evaluate the products' sustainability, consider these qualities:

- Recycled Content - materials derived from waste streams or from production process by-product
- Low embodied energy - the amount of energy required to produce, package, and transport the material
- Reusability/Recyclability - ease of a product to be reused or recycled - take-back programs
- Renewability - derived from materials that are rapidly renewable
- Durability - expected maintenance and life cycle
- Air quality - the effect a material has on the indoor air quality of the home and the effect the production of the material has on the environment
- Produced locally or regionally
- Derived from salvaged materials

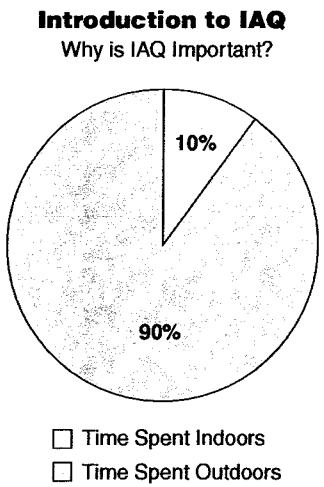
Evaluating choices can be overwhelming. Effort and research are required in order to make appropriate choices about the use of sustainable products. The lasting effects these choices will have when combined with the choices of others will be significant to our environment.

"Making a 10% change on 90% of the projects makes an enormous difference over time."
(Steve Loken, builder and founder of the Center for Resourceful Building Technology)

Indoor Air Quality

The health and safety of the occupants of the home and the people involved in building it are the number one priority. As a minimum, the Kentucky Building Code, local codes and requirements, and OSHA's guidelines for construction safety must be followed.

Beyond adherence to the Building Code and OSHA guidelines, another potential health effect pertains to indoor air quality. This is particularly important because we spend so much time indoors. Indoor pollution sources that release gases or particles into the air are the primary cause of indoor air quality problems in homes. The selection, installation, and maintenance of building components and the occupants activities significantly affect the quality of indoor air and thus the health of the occupants'.



OSHA attributes indoor air problems to

- Ventilation
- Moisture
- Microbial Growth
- Volatile Organic Compounds (VOCs) found in manufactured products
- Odors

Two others to consider are:

- Infestation - bugs, rodents
- Tobacco Smoking

According to the EPA's Map of Radon Zones, which is a quantitative assessment for radon potential listed by county, Fayette County is listed as Zone 1. This means that this area has the highest potential for radon.

Homes should be tested for radon levels. These levels can vary greatly from house to house within the same neighborhood. Radon can also be a problem in well-sealed homes with a crawl space. It is recommended that all homes in Zone 1 should have at least passive radon resistant construction in place. It would be prudent to consider a contingency for an active system if necessary.

Moisture
(Refer to the Checklist following Section 5 Energy Efficiency)

Microbial Growth
Biological contaminants include molds, mildew, bacteria, viruses, animal dander and saliva, house dust, dust mites, cockroaches, and pollen. Many of these thrive in damp, warm environments. To minimize the potential for microbial growth, address the following:

- Eliminate areas of standing water.
- Eliminate water-damaged materials.
- Address sources that create wet surfaces, such as condensation, immediately.
- Frequently clean evaporation trays in air conditioners, dehumidifiers, and refrigerators.
- Practice good housekeeping.
- Minimize wearing of outdoor shoes in the home - especially if wall-to-wall carpet is installed.

Volatile Organic Compounds (VOCs) & Formaldehyde

VOCs are organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform. In selecting specific materials, look for low VOC or rapid decay.

Formaldehyde is a chemical widely used by industry and found in substances such as:
- Permanent press fabrics
- Adhesives and glues
- Paints and coatings
- Interior - Use pressed wood products with urea-formaldehyde (UF)
  Particleboard - subflooring, cabinetry, shelving, furniture
  Hardwood plywood paneling - decorative wall covering, cabinetry, furniture tops
  Medium density fiberboard (MDF) - contains higher resin-to-wood ratio than any other UF pressed wood product
- Exterior - Use pressed wood products with phenol-formaldehyde (PF)
  Softwood plywood
  Flake or oriented standboard

In selecting pressed wood products, use exterior-grade (PF) products even for interior applications.

These products do contain levels of formaldehyde but emit them at much lower rates.

Smoking

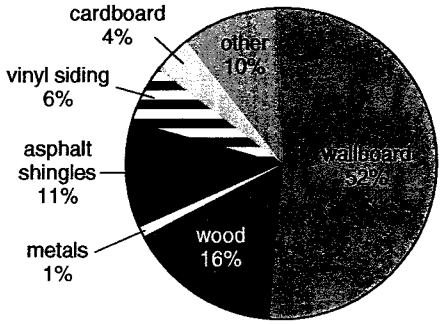
Do not smoke in the house. If smoking indoors cannot be avoided, increase ventilation in the area where smoking occurs.

Carpet
Standard carpet contains much more VOC than standard paint. Wearing outdoor shoes inside the home in conjunction with wall-to-wall carpet also contributes to poor air quality by trapping dust, dirt, allergens, moisture, etc.

Consider the following alternatives:
- Elimination of wall-to-wall carpeting. Use resilient or wood flooring flooring with throw rugs.
- Remove shoes at entry door. Wear indoor slippers inside the house.
- Use Low VOC Carpet. However, for the low-income housing market, the use of this product may be cost prohibitive unless donated or provided at a reduced cost by the manufacturer.

Paint
Use low or no VOC paints inside the home.
Ventilate well during and after painting.

Average Waste Composition by Weight



Durability

Durability provides long-lasting benefits. Providing housing to respond to substandard housing that ends up becoming substandard housing in 15-25 years is shortsighted and does a disservice to the owner and the community.

Waste Reduction

Reducing job-site waste and recycling is beneficial both to builders and to the environment. Using building materials efficiently is one cost effective way to reduce job-site waste. Refer to Section 5 - Energy Efficiency for a discussion on architectural design economies, optimum value engineering, and others. The construction of houses has a tremendous environmental impact.

"The typical 2,000 sq. ft. home uses 16,000 board feet of lumber, plus 6,000 square feet of plywood, all equal to several hundred trees. Builders typically send 4 tons of waste to the landfill for every 2,000 square-foot home."

(Lean & Green, Green Home Inc.)

"Construction of the typical Habitat house generates more than 1½ tons of waste."

(Habitat for Humanity - Material Management Program Manual)

Consider a job-site recycling program. Identify a person responsible for the recycling program. Starting a new system and a new way of thinking is often the most arduous task. Establishing the system requires a person (often site manager) to take ownership of the organization and management of the system. This is important in the office and onsite. Educate everyone working on the jobsite, contractors and volunteers.

Practice deconstruction and salvage. Collect and store large-sized waste materials on the project to used on another later project when possible. Also consider salvaging building products from an architectural salvage company.

Refer to the attached checklist for product information.

The list below was limited to products that were determined to have an immediate application to the affordable housing market. Many, many other products and systems exist. If interested in more information regarding sustainable building products, refer to the attached resource list as a guide to research specific topics or materials.

Site Work

Paving

☐ Crushed rock or recycled concrete rubble as subbase full for pavement.
☐ Porous paving systems - this allows water to enter the soil which limits rainwater runoff. This may be impractical for driveways but should be considered for sidewalks and patios.

Landscaping

☐ Use indigenous plants to reduce need for artificial irrigation and soil amendments.
☐ Use bio-solids and sludge from wastewater treatment facilities as a soil amendment.

Concrete

☐ Cast-in-place - Use 20% flyash in cement. Higher percentages may be used depending upon strength requirements. Locally available.
☐ Reuse and/or recycle formwork where possible.
☐ Insulating concrete forms (ICFs). Formwork made from interlocking rigid foam blocks or panels used for forming foundations or above-grade walls. This system provides improved R-values. Look for recycled content in the form material. Use of this system may result in cost savings by reducing the amount of concrete used and the amount of additional insulation.
☐ Autoclaved cellular concrete (ACC). Lightweight, precast concrete panels or block product. R-values are 5 times greater than standard concrete.
☐ Non-asphalt based damp proofing. Synthetic rubber and cement-based damp proofing that does not contaminate soil or groundwater.

Masonry

☐ Choose locally manufactured products.
☐ For a passive solar application consider use of masonry for energy benefits of a thermal mass.
☐ Use concrete masonry units (CMU) with high-recycled content aggregate where possible.
☐ Use insulation inserts to improve energy efficiency. (Refer to Insulation Section)
☐ Consider interlocking CMU (no mortar) for landscape retaining walls.

Wood & Plastics

Rough Carpentry

☐ Use wood efficiently. Consider Optimum Value Engineering for framing system.
☐ Substituting 2 x 4 or 2 x 6 framing @ 24" centers for 2 x 4 standard framing @ 16" centers.
☐ Consider using salvaged wood products. Common applications: Interior stud wall framing and hardwood flooring
☐ Try not to use treated wood. If required, do not use wood treated with CCA (copper chromium arsenate). Use less toxic CDDC Copper hydroxide sodium dimethyldithiocarbamate) and have treated wood sealed.
☐ Minimize use of wood products with urea-formaldehyde (UF).
☐ Use exterior grade products with (PF) for interior and exterior applications
  Softwood plywood
  Flake or oriented strandboard
☐ Do not use endangered wood species. Refer to Convention on International Trade in Endangered Species (CITES)
☐ Engineered Lumber available for headers, beams, and joists.
  - The lumber consists of small pieces of wood combined with adhesives.
  - Provides uniformity and is stronger than dimensional lumber without affecting old growth forests.
  - Substitute engineered lumber for 2 x 10 or larger.
☐ Use I joists for floors and ceilings. They use 1/3 the material that a typical beam would.
☐ Structural Insulated Panels (SIPs). Commonly made with OSB sheathing laminated to expanded polystyrene foam cores. These panels can be used for wall and roof framing with window/door openings cut in at the manufacturer.
  - Create energy efficient and quiet home
  - Higher initial learning curve and 5%-10% higher envelope cost.
☐ FSC-Certified Lumber - A Forest Stewardship Council certification program. Certifies the practices of forest companies.

Millwork

☐ Finger-jointed interior trim is made of shorter lengths of wood formerly scrapped.
☐ Use water-based adhesives with low VOCs for construction of and installation of plastic laminates where possible.
☐ If millwork substrates contain formaldehyde, require all edges and exposed surfaces to be sealed or encapsulated.

Wood finishing
(Refer to Paints and Coatings)

Thermal and Moisture Protection

Building Insulation
☐ Use insulating materials that do not use CFCs or HCFCs in the manufacturing process.
☐ Plastic foam-board insulation may contain VOCs. This product is not biodegradable. If this type of product must be used, look for products with 10% recycled material content by weight or more.
☐ Spray-applied Foam insulation: Use spray foams that are not blown with CFCs or HCFCs if possible.
☐ Cellulose Insulation: Sprayed cellulose insulation is made from 75%-85% recycled newsprint. It does contain 20% chemical additives for fire retardency requirements. It is biodegradable.

Attention should be given to installation to prevent risk of Indoor air quality problems.

☐ Fibrous Batt and Board Insulation: Use fiberglass that does not contain urea-formaldehyde. Most will contain some level of phenol formaldehyde as a binder.
☐ Use fiberglass insulation with 20%-25% recycled material by weight, as a minimum.
☐ Avoid use of unfaced or non-encapsulated insulation in areas where it is part of the air stream. This can contribute to indoor air quality problems.
☐ If using sound attenuation insulation, use 35% or more recycled glass by weight. Insure that the material is completely encapsulated within the construction. Otherwise, particles can get into the air distribution system and lead to poor indoor air quality.
☐ Keep insulation dry! Fiberglass and mineral fiber materials can easily become great homes for microbial growth.

Roofing
☐ Structural Insulated Panels (refer to Wood & Plastics)
☐ Asphalt - Specify a light-colored, 25 year warranted shingles
☐ Metal Roofing - durable and low maintenance. 100% recycled material content is available

Exterior Cladding
☐ Wood Siding
☐ Compressed wood fiberboard/engineered siding
☐ Fiber-cement siding
☐ Structural Insulated Panels (refer to Concrete)
☐ Engineered wood trim

Joint Sealants
☐ Use low VOC sealants.
- Acrylic latex and/or silicone products < 50 g/l VOC
- Polyurethane products < 100 g/l VOC

Doors and Windows

☐ Use Wood Doors
- Consider using salvages wood interior doors.
- Use low VOC stain and finishes. Refer to "Paints and Coatings"

Glass and Glazing
Glazing R-values

- Clear single-pane glazing: R-1
- Clear double glazing: R-2
- Double glazing with low-E coating: R-3
- Double glazing with two low-E coatings and argon gas between panes: R-4
- Superwindows with a 3¼" overall dimensional and two air spaces: R-12

(A typical R-value for solid exterior walls is R-19. Compare this with the R-values of windows.)

☐ At a minimum, use double-paned glazing.
☐ Use insulated, low-E, gas-filled glass to maximize R-value There are different types of low-e glass. Central Kentucky has significant winter heating and summer cooling requirements, therefore, use "selective transmission low-e" glass.
☐ Use a Solar Heat Gain Coefficient (SHGC) 0.60 or higher for south-facing windows
☐ Select a window with a low U-factor of 0.35 or less to reduce heat transfer and a high visible light transfer (VT) for natural daylighting.
☐ Use shade screen or high-shade coefficient glass on the east and west sides to reduce solar gain by up to 80%.
☐ Use a light-shelf or other means to reduce glare when sun is at low angles.
☐ Use roof mounted "light pipes" instead of skylights. Light pipes or sun tubes capture daylight in a glazed bubble on the roof and pass the light through a reflective tube through the attic into a light-diffusing lens mounted in the ceiling. With an insulating value of up to R-22 and a color-rendering index (CRI) rating of 98.7, light tubes offer an inexpensive alternative to traditional skylights.

Skylights are not recommended.

Window Frames

☐ Traditional wood frames are a good choice. Others include:
☐ Fiberglass and clad frames. They are durable, strong, and low maintenance.
☐ Metal frames are not recommended.

Finishes

Gypsum Drywall Construction

☐ Provide 2'-0" modular for exterior and interior walls where possible.
☐ Use gypsum board with drywall facing paper made of 100% recycled material. (This is very typical in the industry.)
☐ Avoid laminating gypsum board with adhesives.
☐ Use drywall stops and/or clips to minimize wood use.
☐ Use paper joint tape rather than fiberglass.
☐ Use dry-mix joint compound to minimize packaging and transportation waste.
☐ Cover supply/return registers during drywall sanding. Thoroughly clean drywall dust from all surfaces after completion of installation.

Flooring

☐ Use salvaged wood flooring when possible.
☐ For resilient flooring, such as vinyl, consider use of tiles rather than sheet goods.
- Sheet goods have higher VOC content
- Damaged or worn sections can most cost effectively be replaced.
- Use low VOC adhesive: less than 100g/l.

☐ Consider Natural Linoleum made with linseed oil polymer.
- Durable and quiet floor
- Biodegradable
- Comes from renewable resource
- No VOCs
- Dry maintenance system
- 40 year life

Ceramic

☐ Consider using ceramic tile
- Durable, low maintenance, long life, and can add to thermal mass
- Recycled content ceramic tiles are available in many sizes and colors

Carpet

☐ Look for Carpet and Rug Institute (CRI) Indoor Air Quality Testing Program "green label".
☐ High recycled content.
☐ Fusion bonded, needle punched, low pile, tight loop for durability.
☐ Avoid carpet backing with styrene butadiene (SB).
☐ Synthetic fiber carpet such as nylon and polyester.
☐ Solution-dyed is recommended over piece-dyed.
☐ Polyester carpet is not recommended for high traffic areas.
☐ Consider wool fiber carpet with jute backing.
- Durable
- Biodegradable
- Renewable resource

☐ Consider using carpet tile for ease in spot replacement.

Paint & Coatings

☐ Exterior wall color is not as important as roof color, but installation of a light colored surface will absorb less heat.
☐ Light colors on the interior wall surface will assist in natural lighting.
☐ Low VOC finishing on wood flooring.
☐ Low VOC paint.
☐ Use water-based stains and transparent finishes when possible.
☐ Consider using natural stain products that are petroleum free.
☐ Use low VOC stains and transparent finishes with a VOC content less than:
- Stains: 200g/l
- Transparent floor finishes: 250g/l
- Floor coating: 300g/l

Window treatment

☐ Use shading devices for sun control.

Mechanical - refer to Section 5

Plumbing - refer to Section 5

Electrical - refer to Section 5

Links and Resources

Ask an Expert - DOE provides free
general & technical assistance .....E-mail: doe.erec@nciinc.com

Energy Star .....www.energystar.gov/homes
Southface Energy Institute .....www.southface.org
Rocky Mountain Institute .....www.rmi.org
U.S. Department of Energy (DOE) .....www.energy.gov/

Indoor Air Quality
U.S. Department of Energy (DOE) .....www.epa.gov/iaq

Indoor Air Quality Guideline - Formaldehyde in the Home
An Update on Formaldehyde:
1997 Revision
CPSC document #725, U.S. Consumer Product Safety Commission

Biological Pollutants in Your Home
January 1990 (402-F-90-102)
American Lung Association and U.S. Consumer Product Safety Commission

Used Building Materials
"Building Materials" .....See Yellow Pages
"Building Materials - Used" .....See Yellow Pages

DESIGN CONCEPTS

Section 7

Introduction

Shotgun 1-A
Shotgun Camel Back 1-B

One - Story 2-A
One - Story Modification 2-B
One - Story Modification 2-C

Two - Story 3-A
Two - Story Modifications 3-B

In the previous sections, concepts and options pertaining to site evaluation, energy efficiency, and sustainability have been explored. Builders and homeowners often underutilize these concepts because they are unseen. This section suggests a few design concepts that focus on house layout and appearance.

Design Approach

Affordable housing would not be very affordable if each house were completely unique (custom). Repetitive fabrication and mass produced products are key components to saving money. With this in mind, the approach in this document is to identify basic design components that can be easily modified or varied to respond to individual project requirements. This approach assumes that multiple dwellings will be built over time in order to maximize the effectiveness of this methodology. However, applying this strategy to the major elements can produce a variety of combinations and applications on standard floor plan layouts to provide richness, variety, and an opportunity for the project to adequately respond to a range of neighborhood contexts.

This is important because...

One size does not fit all...

...and one floor plan or exterior treatment does not suit all situations in terms of the homeowner's needs and/or neighborhood compatibility.

Floor Plans

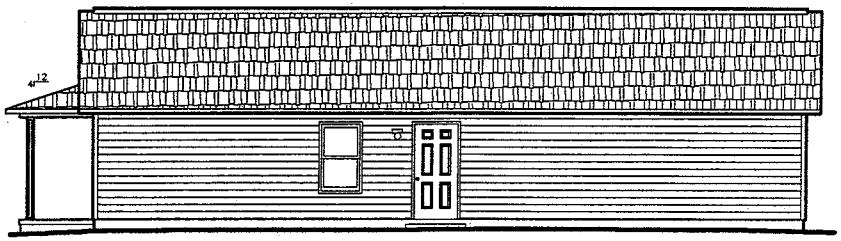
Develop a series of floor plans that respond to different neighborhood scales and lot sizes, are adaptable, and work economically. Variations on these base schemes can then be developed to respond to differing site and neighborhood conditions.

Exterior Elevations

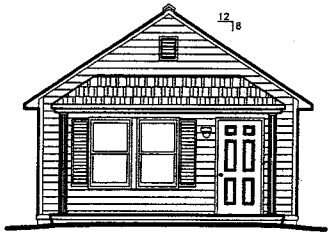
The basic floor plan layouts can be modified and adapted by means of minor plan modifications, roof modifications, porch design options, window size and placement, and material selections. In order to respond appropriately to the cost constraints and provide variety, consider developing a limited palette of components and materials that can be adapted and recombined to suit unique lot conditions.

Once this concept is developed with the participation of subcontractors, suppliers, fabricators, and often, volunteer workers, this approach could be very cost-effective, and result in new, varied and compatible infill designs.

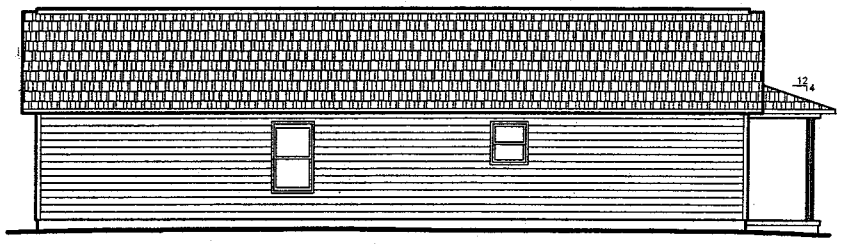
Shotgun 1-A



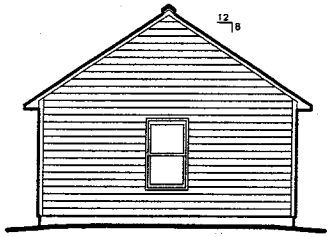
SIDE ELEVATION



FRONT ELEVATION

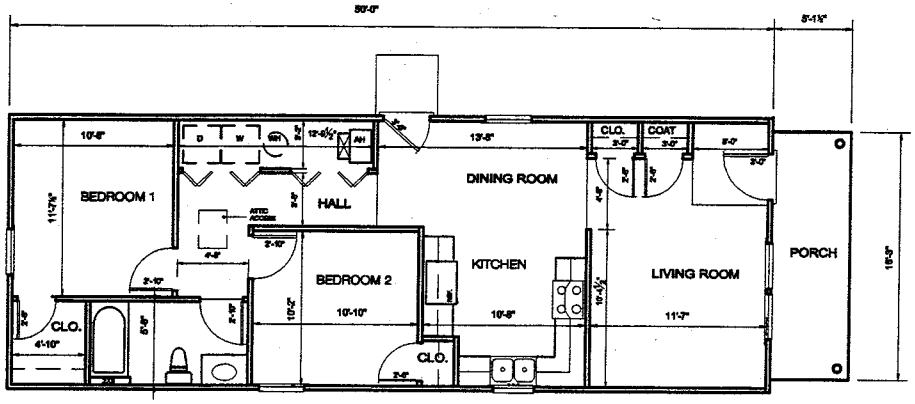


SIDE ELEVATION



REAR ELEVATION

Shotgun 1-A



FIRST FLOOR PLAN

This example is Lexington Habitat for Humanity's basic 2-bedroom Shotgun home.

Site

- The lot sizes for the application of this 18'-0" x 50'-0" floor plan are typically very narrow and not very deep. This puts a significant limitation on the buildable area. (Refer to Section 4)
- Often these lots present unique development difficulties due to lot size.

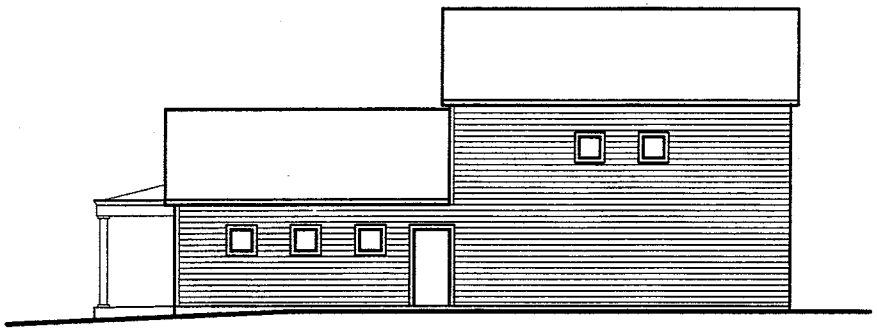
Floor Plan

- The floor plan is very efficient and is based on a 24" grid.
- The day spaces can be vaulted to maximize the use of space and make small spaces seem much larger and more comfortable.
- A side door at grade is provided to fulfill handicap access. (Visitability is a requirement for government-subsidized housing)
- There is no preferential treatment given to environmental orientation.

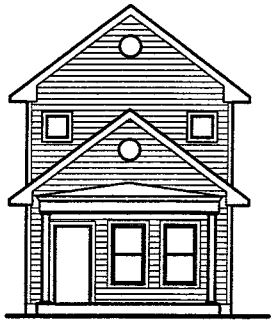
Elevation

- The main roof is sloped at 8:12 to be compatible with roofs that may range from 9:12 - 12:12
- The shutters and round columns give a colonial appearance

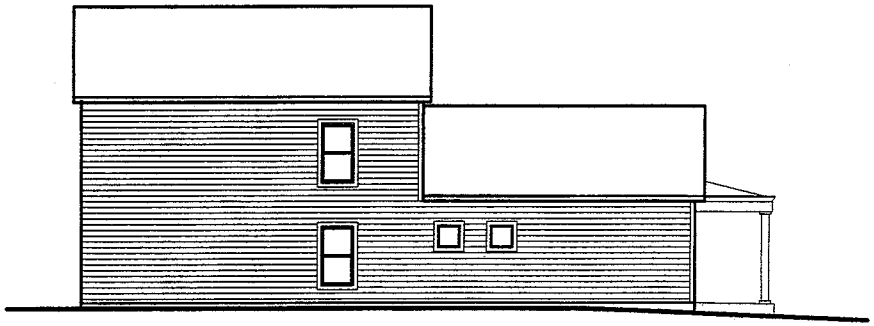
Shotgun 1-B
(camel-back)



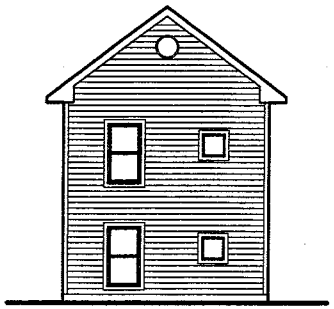
SIDE ELEVATION



FRONT ELEVATION

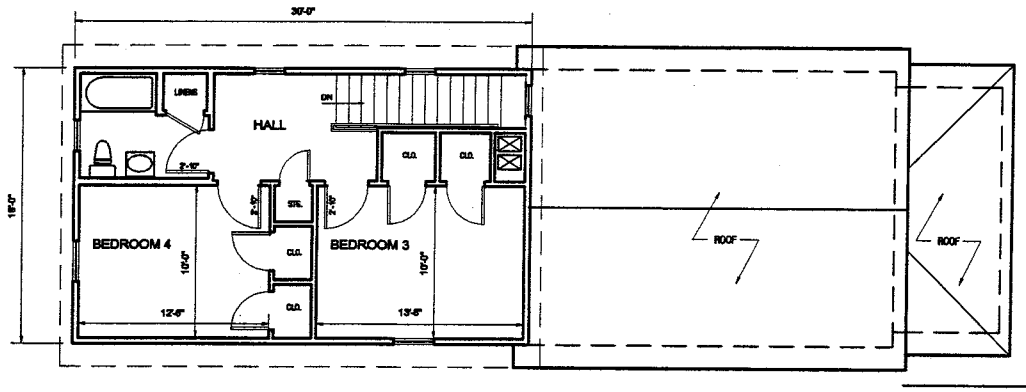


SIDE ELEVATION

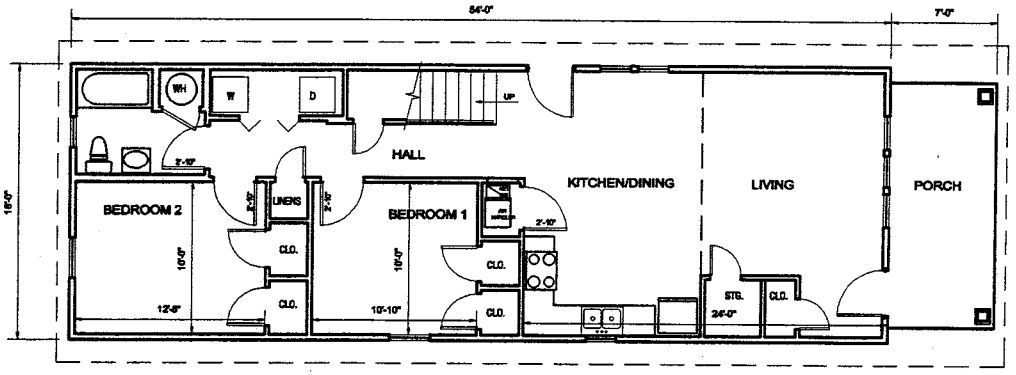


REAR ELEVATION

Shotgun 1-B
(camel-back)



SECOND FLOOR PLAN



FIRST FLOOR PLAN

This example is a modification to Lexington Habitat for Humanity's basic 2-bedroom Shotgun home.

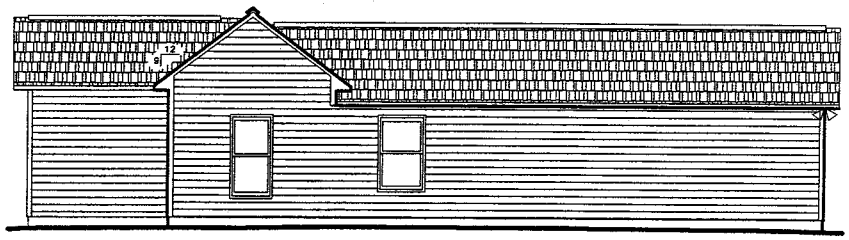
Site
- An 18'-0" x 54'-0" "camel-back" layout was developed to respond to the buildable area limitations and market demand for more bedrooms.

Floor Plan
- The floor plan is very similar to the base plan with the back half of the house adapted to stack 2 bedrooms and a bath on each level.
- The second story of the house was limited to the rear, in order to be compatible in shotgun neighborhoods. The single-story along the street frontage maintains the scale of the neighborhood.

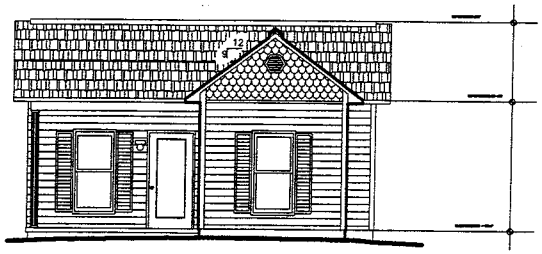
Elevation
- The main roofs are sloped at 9:12 to be compatible with roofs that may range from 9:12 - 12:12.
- The shutters were removed (colonial style) and the front windows spaced out further.
- The porch has a deeper porch beam with a shallow-sloped roof to appear more substantial and compatible.
  (Porches need to be deep enough to accommodate porch furniture or a porch swing so that people will use them.)
- A raised slab for the porch was used to be compatible with the typical crawl-space foundation of the older dwellings. A side door at grade is provided to fulfill handicap access. (Visitability is a requirement for government-subsidized housing)
- More windows can be integrated on the exposed side of a corner lot, if needed.

Modified Shotgun - Floor Plan Concept

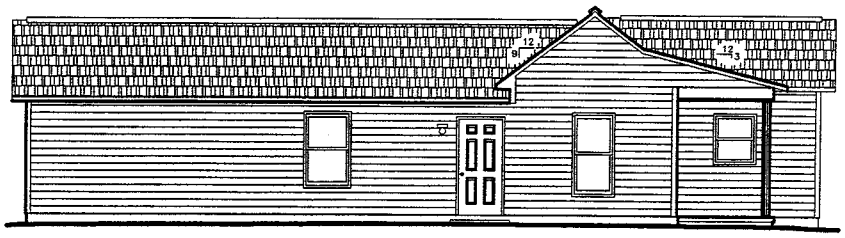
Single Story 2-A



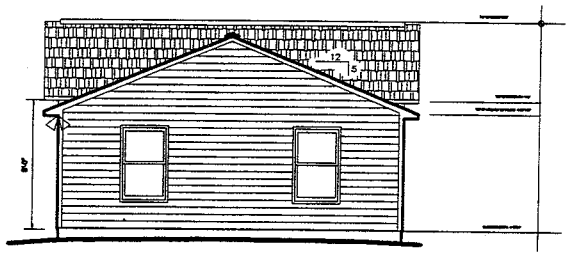
SIDE ELEVATION



FRONT ELEVATION

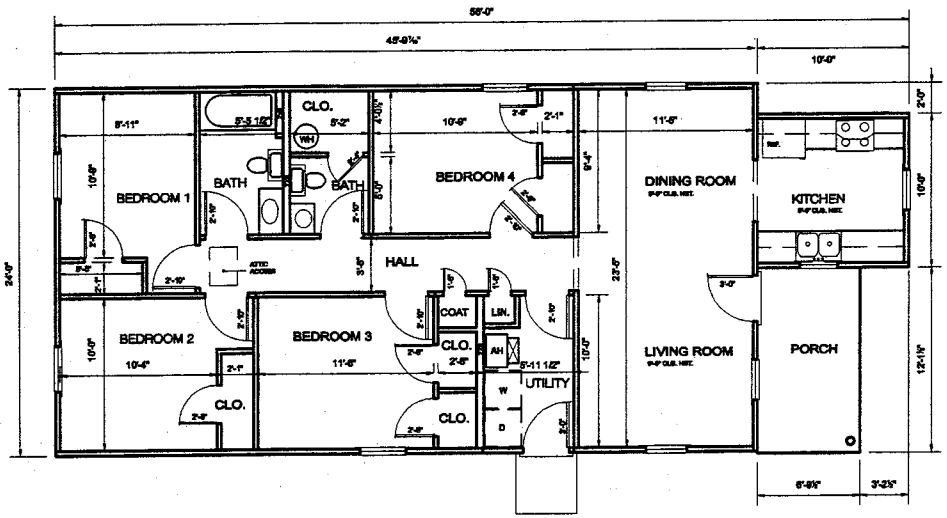


SIDE ELEVATION



REAR ELEVATION

Single Story 2-A



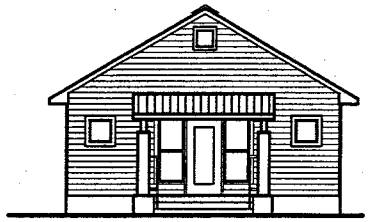
FIRST FLOOR PLAN

This example is Lexington Habitat for Humanity's historic 4-bedroom single-story home.

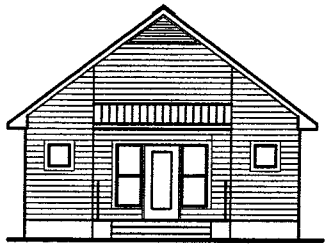
Site
- The lot sizes for the application of this 24'-0" x 56'-0" floor plan are readily found throughout the target area.

Floor Plan
- The floor plan is very efficient and is based on a 24" grid.
- The volume of the kitchen has been separated out from the main house to provide a reduced scale feature and detail.
- The day spaces can be vaulted to maximize the use of space and make small spaces seem much larger and more comfortable.
- A side door at grade is provided to fulfill handicap access. (Visitability is a requirement for government-subsidized housing)

Elevation
- The kitchen and living/dining room roofs are sloped at 9:12 to be compatible with roofs that may range from 9:12 - 12:12. The bedroom area roof is sloped at 5:12 to be volunteer friendly.
- The shutters, fish scale shingles, and round columns and/or railings provide additional detail and scale.
- More windows can be integrated on the exposed side of a corner lot, if needed.



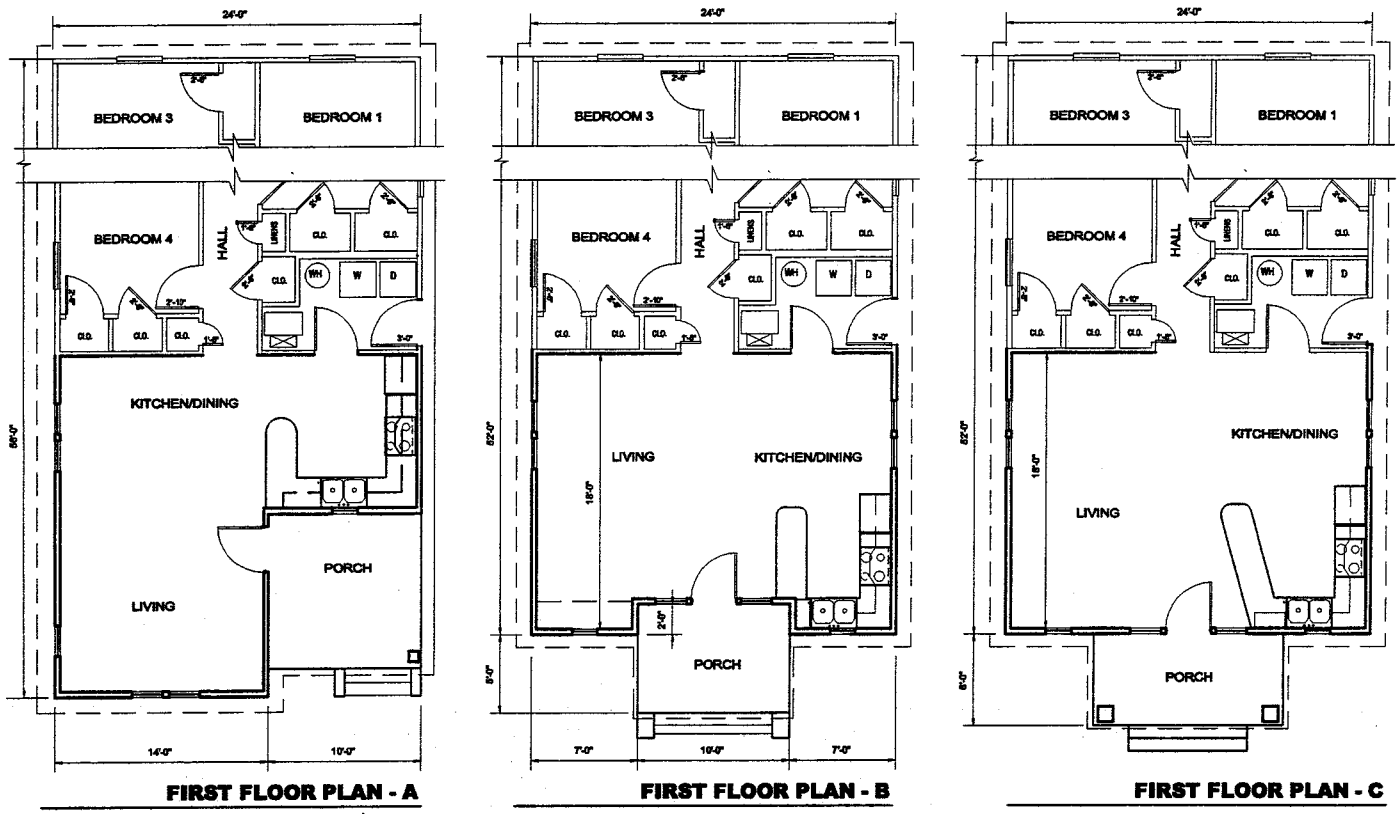
FRONT ELEVATION - 1



FRONT ELEVATION - 2

FRONT ELEVATION - 3

FRONT ELEVATION - 4



FIRST FLOOR PLAN - A

FIRST FLOOR PLAN - B

FIRST FLOOR PLAN - C

This example is a modification to Lexington Habitat for Humanity's historic 4-bedroom single - story home shown on page 75, single-story 2-A.

Floor Plan

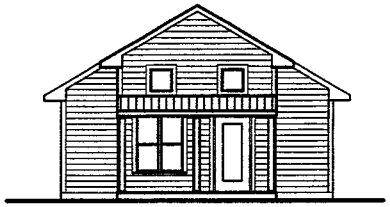
- Develop different variations of the basic layout to respond to environmental conditions and neighborhood context.
- Three variations on the historic model are shown. These layouts modify only the front day spaces of the home. The bedroom layout is unaffected.
- The day spaces can be vaulted to maximize the use of space and make small spaces seems much larger and more comfortable.

Elevation

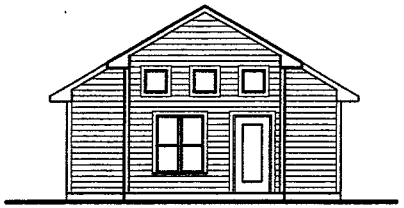
- Develop variation on the basic elevation concept to respond to environmental conditions and neighborhood context.
- Four elevation variations are shown on the modified basic 4-bedroom layout. Consider modification of:
  - Roof slopes
  - Porch sizes and details
  - Window placement and size
- A raised slab for the porch was used to be compatible with the typical crawl-space foundation of the older dwellings. A side door at grade is provided to fulfill handicap access. (Visitability is a requirement for government-subsidized housing)

Modified Single Story - Floor Plan Concepts

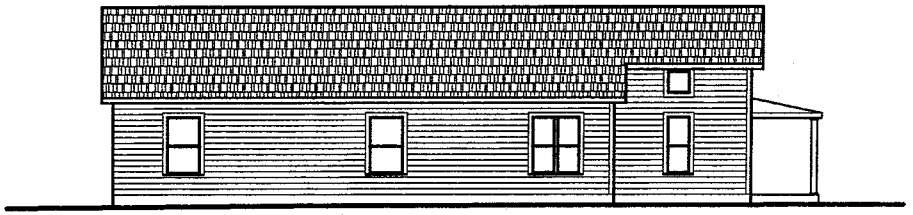
FRONT ELEVATION - 1



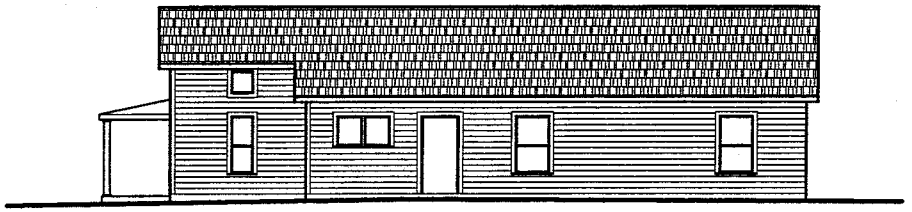
FRONT ELEVATION - 2



FRONT ELEVATION - 3

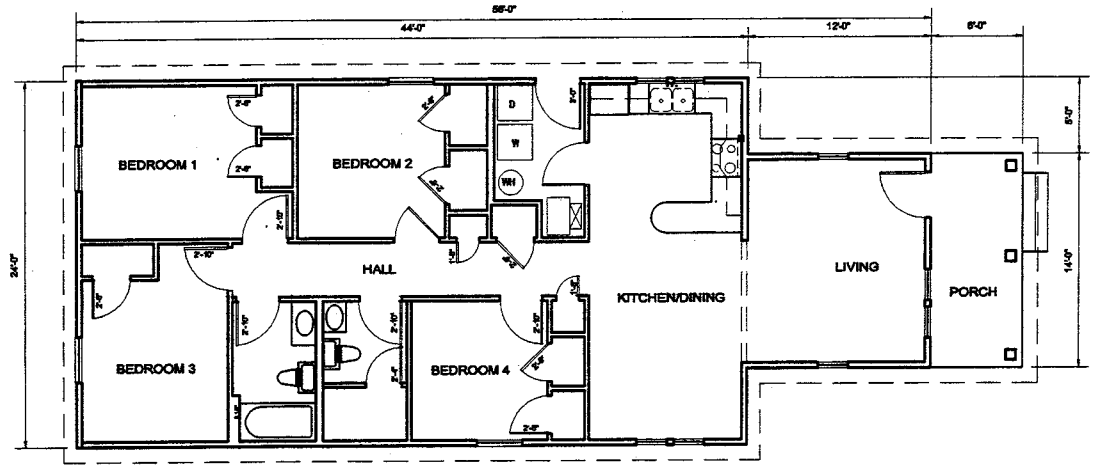


SIDE ELEVATION



SIDE ELEVATION

Modified Single Story - Elevation Concepts



FIRST FLOOR PLAN

This example is a modification to Lexington Habitat for Humanity's historic 4-bedroom single story home - Single-Story 2A.

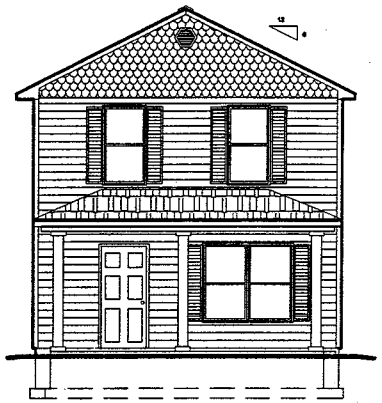
Floor Plan

- Develop different variations of the basic layout to respond to environmental conditions and neighborhood context.
- The living room volume was separated out instead of the kitchen. This provides for a larger scale feature. The bedroom layout is unaffected.
- An optional vaulted space can be limited to the living room, or could include the kitchen/dining area.

Elevation

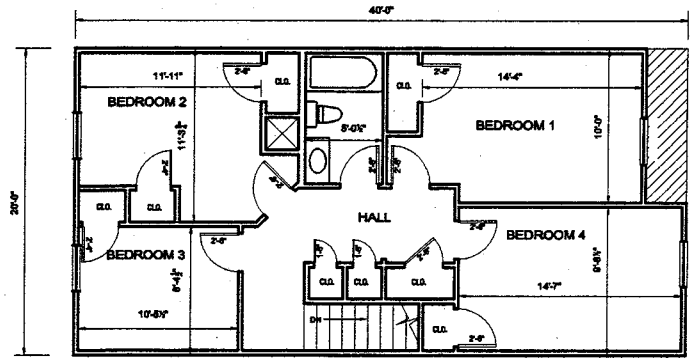
- Three elevation variations are shown.
- The potential vertical emphasis of the living room volume can be very compatible in some Victorian neighborhoods.
- The elevation study shows a progression from an unvaulted living area to a vaulted living area. The third option is shown for neighborhoods that may not have a pattern of porches.

Modified Single - Story - Floor Plan Concept

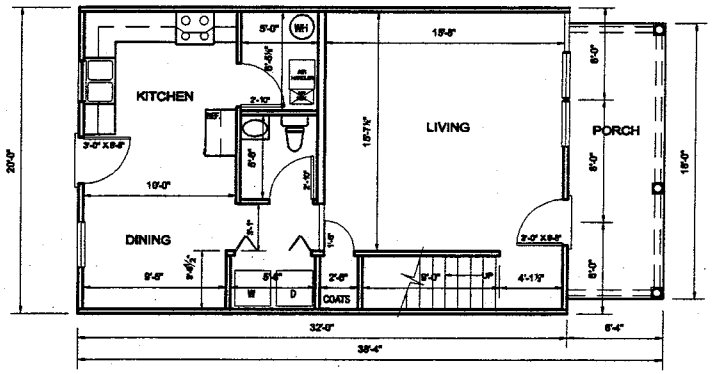


FRONT ELEVATION

REAR ELEVATION



SECOND FLOOR PLAN



FIRST FLOOR PLAN

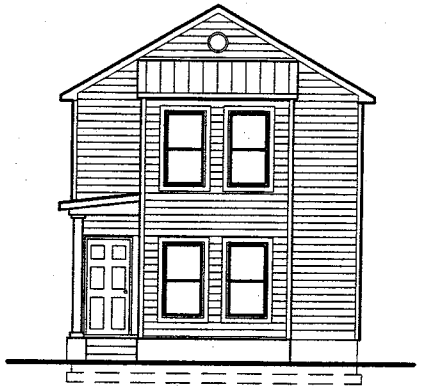
This example is Lexington Habitat for Humanity's basic 4-bedroom two-story home.

Site
- The lot sizes for the application of this 20'-0" x 32'-0" floor plan are readily found throughout the target area.

Floor Plan
- The floor plan is very efficient and is based on a 24" grid.
- The living area is separated from the dining/kitchen.
- Plumbing is stacked.

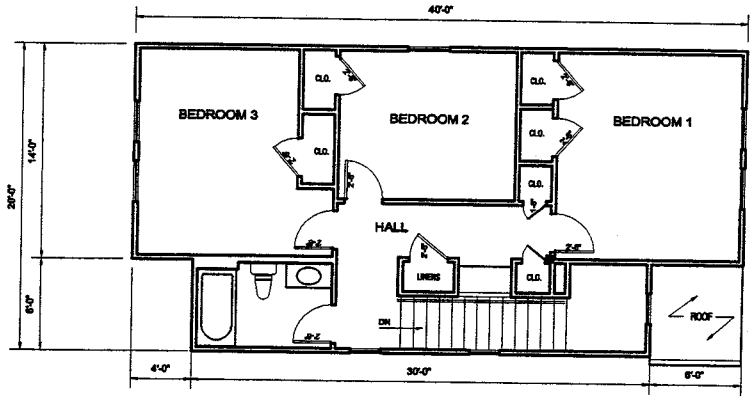
Elevation
- The roof is sloped at 6:12 to be volunteer friendly.
- The shutters, fish scale shingles, and round columns are a mix of colonial and Victorian details, but they provide additional detail and scale.
- There are no windows on either side of the house.

FRONT ELEVATION - 1

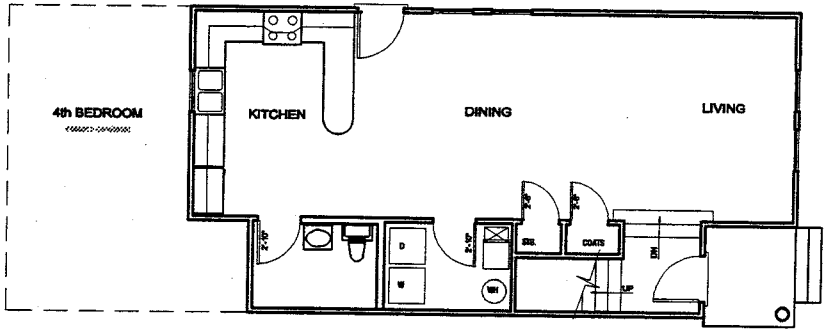


FRONT ELEVATION - 2

FRONT ELEVATION - 3



SECOND FLOOR PLAN



FIRST FLOOR PLAN

This example is a modification to Lexington Habitat for Humanity's basic 4-bedroom two-story home - Two-Story 3A.

Site
- Depending upon the site, the day spaces can be oriented to the south.

Floor Plan
- Open floor plan layout to maximize natural light and ventilation.
- Utility/service areas stacked to energy efficiency.
- This option incorporates a raised porch/sunken living room (Living room actually at grade) in order to be more compatible with the raised porches over crawl spaces that are very typical. The stair landing is used to transition the elevation change on the interior.

Elevation
- Three elevation variations are shown.
- The vertical emphasis can be very compatible in some Victorian neighborhoods.
- The rear-sloping roof option can be very compatible in some neighborhoods - probably closer to the core business district. dfdf

Modified Two Story - Floor Plan Concept

Any questions or inquires regarding the contents and availability of this document should be directed to Lexington-Fayette Urban County Government Planning Division, (859) 258-3174.

Copies will be made available from the Lexington Fayette Urban County Government Planning Division.